User's Manual

AQ2200 Series Multi-Application Test System Startup Guide

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM 735101-01EN
5th Edition

Product Registration

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Please allow us to serve you best by completing the product registration form accessible from our homepage.

http://tmi.yokogawa.com/

Foreword

Thank you for purchasing this AQ2200 Series Multi Application Test System. This user's manual explains the features, operating procedures, and handling precautions of the AQ2200 Series. To ensure correct use, please read this manual thoroughly before operation. Keep this manual in a safe place for quick reference in the event a question arises.
In addition to this manual, the following seven kinds of manuals are provided for the AQ2200 Series. Please read all manuals.

Manual Title	Manual No.	Description
AQ2200 Series Multi Application Test System User's Manual (Startup Guide)	IM 735101-01EN	This manual. This manual describes the handling precautions for, the names and functions of all parts of, and the firmware upgrade procedure for the AQ2200 Series. The supplied CD contains the PDF file of this manual.
AQ2200 Series Multi Application Test System User's Manual (Frame and Module Operation)	IM 735101-03EN	The supplied CD contains the PDF file of this manual. This manual describes all the features of the AQ2200 Series and how to use them, with the exception of some of the application and communication features.
AQ2200 Series Multi Application Test System User's Manual (Application Operation)	IM 735101-04EN	The supplied CD contains the PDF file of this manual. This manual describes the AQ2200 Series application features and how to use them.
AQ2200 Series Multi Application Test System Communication Interface User's Manual	IM735101-17EN	The supplied CD contains the PDF file of this manual. This manual describes the AQ2200 Series communication interface features and how to use them.
64 Mbit Program Pattern Option User's Manual	IM 810518801-61E	This manual describes how to create program patterns for the AQ2200-601 10 Gbit/s BERT module with the /M option.
SDH/SONET Frame Option User's Manual	IM 810518801-62E	This manual describes how to create SDH/SONET patterns for the AQ2200-601 10 Gbit/s BERT module with the /P1 option.
Checking the Package Contents for AQ2200 Series Modules and Module Handling Precautions	IM 810518901-04E	This is included with AQ2200 Series modules. It explains the handling precautions of the module and lists the package contents.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
  The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA is strictly prohibited.

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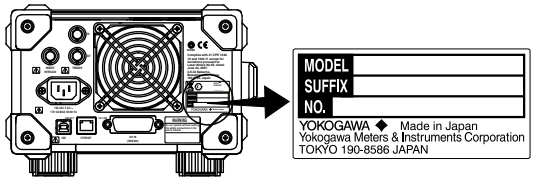
Revisions

- 1st Edition: Augast 2009
- 2nd Edition: November 2009
- 3rd Edition: January 2010
- 4th Edition: March 2010
- 5th Edition: November 2012

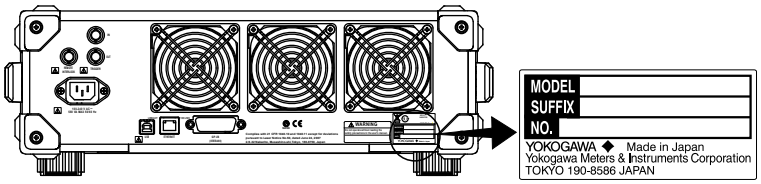
Checking the Package Contents

After receiving the product and opening the package, check the items described below. If the wrong items have been delivered, if items are missing, or if there is a problem with the appearance of the items, contact your nearest YOKOGAWA dealer. When contacting the dealer from which you purchased the instrument, please give them the instrument number.
Also, check that the model name and suffix code given on the name plate on the side panel of the module are the same as those on your order.

AQ2211 Frame Controller



AQ2212 Frame Controller



AQ2211/AQ2212 Frame Controller

Model	Suffix Code	Description
735101		AQ2211 (Three slots)
735102		AQ2212 (Nine slots)
Power cord	-D	UL,CSA Standard Power cord
	-F	VDE Standard power cord
	-R	AS Standard power cord
	-Q	BS Standard power cord
	-H	GB Standard power cord (CCC-compatible)

No. (Instrument number)

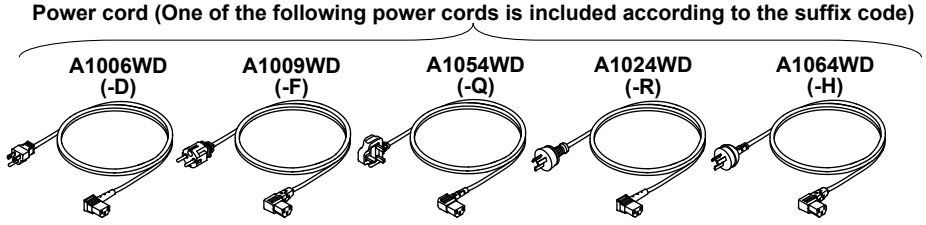
When contacting the dealer from which you purchased the instrument, please give them the instrument number.

Accessories

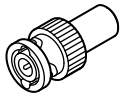
The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
Power cord		1	
Interlock connector plug	A1288JA	1	
CD-ROM (User's manuals) Printed manuals can be purchased separately. Contact your nearest YOKOGAWA dealer to purchase a copy.	B8085NZ	1	Includes the following user's manuals: • Startup Guide • Frame and Module Operation • Application Operation • Communication Interface
User's Manual	IM 735101-01EN	1	This manual
Rubber feet	A9088ZM	1	

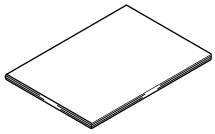
Power cord (One of the following power cords is included according to the suffix code)



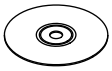
Interlock connector plug
A1288JA



User's manual (this manual)
IM 735101-01EN



User's manual
B8085NZ (CD-ROM)



Rubber feet
A9088ZM

Optional Accessories (Sold separately)

The following optional accessories are available for purchase separately. For information about ordering accessories, contact your nearest YOKOGAWA dealer.

Product Name	Model or Part No.	Specifications
AQ2200-901 blank panel	810518926	1-slot size
AQ2211 rack mount kit	735182-03	For mounting one AQ2211 to the left side of an EIA-standard rack.
AQ2212 rack mount kit	735182-09	For mounting one AQ2212 to an EIA-standard rack.

How to Use the CD-ROM (User's Manuals)

The CD-ROM contains PDF files of the following user's manuals.

- AQ2200 Series Multi-Application Test System User's Manual (Startup Guide) IM 735101-01EN
- AQ2200 Series Multi-Application Test System User's Manual (Frame and Module Operation) IM 735101-03EN
- AQ2200 Series Multi-Application Test System User's Manual (Application Operation) IM 735101-04EN
- AQ2200 Series Multi-Application Test System Communication Interface User's Manual IM 735101-17EN

To view the manuals above, you need Adobe Reader 5.0 or later.

WARNING

Never play this CD-ROM in an audio CD player.
Doing so may cause loss of hearing or speaker damage due to the high-volume sound that may be produced.

Safety Precautions

This instrument is an IEC safety class I instrument (provided with a terminal for protective earth grounding).
The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. YOKOGAWA assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.

Handle with care. To protect the instrument and its users, refer to the explanation in the User's Manual or Service Manual.

Alternating current

Power-on state

Power-off state

Laser radiation hazard

Power on

Power off

Failure to comply with the precautions below could lead to injury or death or damage to the instrument.

WARNING

Use the Instrument Only for Its Intended Purpose
This optical measuring instrument is designed to measure the optical characteristics of light sources and evaluate their performance. Do not use this instrument for anything other than as an optical measuring instrument.

Check the Physical Appearance
Do not use the instrument if there is a problem with its physical appearance.

Power Supply
Make sure that the power supply voltage matches the instrument's rated supply voltage and that it does not exceed the maximum voltage range specified for the power cord.

Use the Correct Power Cord and Plug
To prevent fire and electric shock, use only a power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. The earth protection will be nullified if you use an ungrounded extension cord.

Connect to a Protective Earth Terminal
To prevent electric shock, be sure to connect to a protective earth terminal before turning on the frame controller's power. The power cord that comes with the frame controller is a three-prong cord. Connect the power cord to a properly grounded three-prong outlet.

Do Not Impair the Protective Grounding
Never cut off the frame controller's internal or external protective earth wire or disconnect the wiring to the protective earth terminal. Doing so may result in electric shock or damage to the instrument.

Do Not Operate with Defective Protective Grounding or Fuses
Do not operate the frame controller if its protective grounding or one of its fuses might be defective. Check the grounding and the fuses before operating the frame controller.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable gasses or vapors. Doing so is extremely dangerous.

Do Not Remove Covers
Only qualified YOKOGAWA personnel should remove the instrument's covers. The inside of the frame controller is dangerous because parts of it have high voltages.

Ground the Instrument before Making External Connections
Securely connect the protective grounding before connecting to the item under measurement or to an external control unit. Before touching a circuit, turn off its power and check that it has no voltage.

Avoid Electric Shock When Using the Modules

Do not apply an input voltage that exceeds the maximum input voltage, withstand voltage, or allowable surge voltage.

To prevent the possibility of electric shock, be sure to fasten the screws that are at the bottom of the front panel of 2-slot and 3-slot modules. Otherwise, the electrical and mechanical protection functions will not be activated.

Do not leave the modules connected to the instrument in environments in which a voltage equal to or greater than the allowable surge voltage may occur.

Dispose the Instrument Properly

Do not throw this instrument into a fire to dispose of it. Doing so may cause the instrument to explode, resulting in fire or personal injury.

The devices used in this instrument contain gallium arsenide (GaAs) and indium phosphide (InP). When you dispose this instrument, you must separate it from general industrial waste and household garbage, and dispose of it according to local regulations.

Additionally, gallium arsenide powder and vapor are dangerous substances. Do not burn, cut, crush, chemically disassemble, or otherwise destroy this instrument.

This instrument is a "Class 1M Laser Product" as Defined in "IEC60825-1, 2007."

Never look at the optical output section or the end of the optical fiber that is connected to the optical output section during laser beam generation. Using an optical instrument, such as a loupe, magnifying glass, or microscope, when observing the laser beam from a distance of less than 100 mm may cause eye injury. The laser beam that this instrument uses cannot be seen by the human eye. However, the laser beam is extremely hazardous to the human eye and eyesight if it happens to hit the eye.

Install or Use the Instrument in Appropriate Locations

- Do not install or use the instrument outdoors or in locations subject to rain or water.
- Install the instrument so that you can immediately remove the power cord if an abnormal or dangerous condition occurs.

CAUTION

Operating Environment Limitations

This is a class A instrument designed for an industrial environment. Operation of this equipment in a residential area can cause radio interference, in which case users will be required to correct the interference.

Safety Precautions for Laser Products

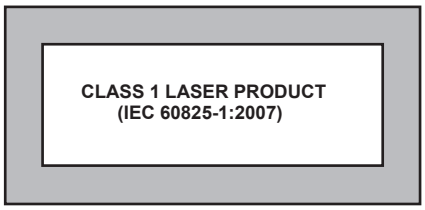
This instrument uses a laser light source. This instrument is a Class 1M laser product as defined by IEC60825-1 Safety of Laser Products—Part1: Equipment Classification and Requirements. In addition, this instrument complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

Laser Class 1M Label

Using an optical instrument, such as a loupe, magnifying glass, or microscope, when observing the laser beam from a distance of less than 100 mm may cause eye injury.

Laser Class 1 Label

Using an optical instrument, such as a loupe, magnifying glass, or microscope, when observing the laser beam from a distance of less than 100 mm may cause eye injury.



Model	Class	Laser Type	Center Wavelength	Maximum Output Power	Mode Field Diameter	Numerical Aperture
810518901	1M	DFB-Laser	1310 to 1650 nm	40 mW	9 μm	0.1
810518902	1	FP-Laser	1310/1550 nm	10 mW	9 μm	0.1
810518903	1	FP-Laser	1310/1550 nm	10 mW	9 μm	0.1
810518904	1M	EC-Laser	1440 to 1640 nm	50.2 mW	9 μm	0.1
AQ2200131	1M	ITLA	1527.60 to 1608.76 nm	40 mW	9 μm	0.1
AQ2200132	1M	ITLA	1527.60 to 1608.76 nm	40 mW	9 μm	0.1

Note

- Commercially available XFP transceivers installed in the AQ2200-641 XFP Interface Module are not covered under warranty.
- For save handling of the laser, consult the user's manual that came with the XFP transceiver.

Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is only valid in the EU.)

This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

New EU Battery Directive

New EU Battery Directive, DIRECTIVE 2006/66/EC
(This directive is valid in the EU only.)

Batteries are included in this product. This marking indicates they shall be sorted out and collected as ordained in ANNEX II in DIRECTIVE 2006/66/EC.

Battery type

Lithium battery

You cannot replace batteries by yourself. When you need to replace batteries, contact your local Yokogawa Europe B.V.office.

Conventions Used in This Manual

Notes and Cautions

The notes and cautions in this manual are categorized using the following symbols.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user' s manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attention to actions or conditions that could cause light injury to the user, or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for proper operation of the instrument.

Character Notations

Bold characters in procedural explanations are used to indicate panel keys and soft keys that are used in the procedure and menu items that appear on the screen.

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Module Model Name, Suffix Code, and Accessories

AQ2200-111 DFB-LD Module

Model	Suffix Code	Description
810518901		-
Wavelength	-Mxxxx	See section 5.2 for the list of supported wavelengths
	-W1310	1310 nm
	-W1490	1490 nm
Optical connector	-FCA	FC/Angled PC connector
Optical output level	-P10	10 mW optical output
	-P20	20 mW optical output
Optical fiber	-SMF	SM fiber
	-PMF	PM fiber
External modulation	-MODN	No external modulation
	-MODS	External modulation (sine)
	-MODC	External modulation (chop)

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-141 FP-LD Module

Model	Suffix Code	Description
810518902		-
Wavelength	-W1310	1310 nm
	-W1550	1550 nm
Optical connector	/FCC	AQ9441(FC) universal adapter
	/SCC	AQ9441(SC) universal adapter

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model	Notes
AQ9441(FC) universal adapter	813917321-FCC	FC connector
AQ9441(SC) universal adapter	813917321-SCC	SC connector

AQ2200-142 DUAL FP-LD Module

Model	Suffix Code	Description
810518903		-
Wavelength	-W135D	1310/1550 nm
Optical connector	/FCC	AQ9441(FC) universal adapter
	/SCC	AQ9441(SC) universal adapter

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model	Notes
AQ9441(FC) universal adapter	813917321-FCC	FC connector
AQ9441(SC) universal adapter	813917321-SCC	SC connector

AQ2200-131 Grid TLS Module

Model	Suffix Code	Description
AQ2200131		-
Wavelength	-C	C-band
	-L	L-band
LD type	-T4	Standard type
	-T2	Advanced type (Fine tuning)
Optical fiber	-PA	PM fiber
Optical connector	-FCC	FC/PC connector
	-FCA	FC/Angled PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-132 Grid TLS Module

Model	Suffix Code	Description
AQ2200132		-
Wavelength	-CC	CH1:C-band, CH2:C-band
	-LL	CH1:L-band, CH2:L-band
	-CL	CH1:C-band, CH2:L-band
LD type	-T4	Standard type
	-T2	Advanced type (Fine tuning)
Optical fiber	-PA	PM fiber
Optical connector	-FCC	FC/PC connector
	-FCA	FC/Angled PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-136 TLS Module

Model	Suffix Code	Description
810518904		-
Optical connector	-FCA	FC/Angled PC connector
Optical fiber	-SMF	SM fiber
Wavelength	-WLSTD	Changeable

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-201 Interface Module

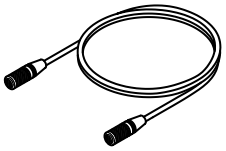
Model	Suffix Code	Description
810518905		

Accessories

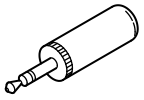
The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
Analog out plug	955-230002662	1	
Optical sensor head connector cable	955-850002026	1	
User's manual	IM 810518901-04E	1	Read before using the instrument

Optical sensor head connector cable
955-850002026



Analog out plug
955-230002662



Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Part No.	Notes
Analog out plug	955-230002662	

AQ2200-231 Optical Sensor Head

Model	Suffix Code	Description
810518906		Large-aperture, long-wavelength sensor
Connector adapter	/FCC	AQ9355C (FC) connector adapter with a light shielding cap
	/SCC	AQ9335C (SC) connector adapter with a light shielding cap
	/STC	AQ9335C (ST) connector adapter with a light shielding cap

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model or Part No.	Notes
AQ9335C (FC) connector adapter	810518909-FCC	FC connector
AQ9335C (SC) connector adapter	810518910-SCC	SC connector
AQ9335C (ST) connector adapter	810518911-STC	ST connector
AQ9335C (LC) connector adapter	M3407JD	LC connector with a dust protection cap
AQ9335C (MU) connector adapter	M3407JE	MU connector with a dust protection cap
Light shielding cap (FC)	810518912-FCC	Light shielding cap for an FC connector
Light shielding cap (SC)	810518913-SCC	Light shielding cap for an SC connector
Light shielding cap (ST)	810518914-STC	Light shielding cap for an ST connector
AQ9346 tape fiber adapter	810517917	
AQ9302 (125) bare fiber adapter	819705500-0125	
AQ9440B MT connector	810517921-B	2, 4, 8, and 12 cores
Dust protection cap (LC)	M3407HD	Dust protection cap for an LC connector
Dust protection cap (MU)	M3407HE	Dust protection cap for an MU connector

AQ2200-241 Optical Sensor Head

Model	Suffix Code	Description
810518907		Large-aperture, short-wavelength sensor
Connector adapter	/FCC	AQ9355C (FC) connector adapter with a light shielding cap
	/SCC	AQ9335C (SC) connector adapter with a light shielding cap
	/STC	AQ9335C (ST) connector adapter with a light shielding cap

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model or Part No.	Notes
AQ9335C (FC) connector adapter	810518909-FCC	FC connector
AQ9335C (SC) connector adapter	810518910-SCC	SC connector
AQ9335C (ST) connector adapter	810518911-STC	ST connector
AQ9335C (LC) connector adapter	M3407JD	LC connector with a dust protection cap
AQ9335C (MU) connector adapter	M3407JE	MU connector with a dust protection cap
Light shielding cap (FC)	810518912-FCC	Light shielding cap for an FC connector
Light shielding cap (SC)	810518913-SCC	Light shielding cap for an SC connector
Light shielding cap (ST)	810518914-STC	Light shielding cap for an ST connector
AQ9346 tape fiber adapter	810517917	
AQ9302 (125) bare fiber adapter	819705500-0125	
AQ9440B MT connector	810517921-B	2, 4, 8, and 12 cores
Dust protection cap (LC)	M3407HD	Dust protection cap for an LC connector
Dust protection cap (MU)	M3407HE	Dust protection cap for an MU connector

AQ2200-211 Sensor Module

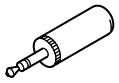
Model	Suffix Code	Description
810518908		Highly sensitive, long-wavelength sensor
Connector adapter	/FCC	AQ9447 (FC) connector adapter with a light shielding cap
	/SCC	AQ9447 (SC) connector adapter with a light shielding cap
	/STC	AQ9447 (ST) connector adapter with a light shielding cap

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
Analog out plug	955-230002662	1	
User's manual	IM 810518901-04E	1	Read before using the instrument

Analog out plug
955-230002662



Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model or Part No.	Notes
AQ9447 (FC) connector adapter	810804602-FCC	FC connector
AQ9447 (SC) connector adapter	810804602-SCC	SC connector
AQ9447 (ST) connector adapter	810804602-STC	ST connector
Light shielding cap (FC)	810518912-FCC	Light shielding cap for an FC connector
Light shielding cap (SC)	810518913-SCC	Light shielding cap for an SC connector
Light shielding cap (ST)	810518914-STC	Light shielding cap for an ST connector
AQ9346 tape fiber adapter	810517917	
AQ9302 (125) bare fiber adapter	819705500-0125	
AQ9440B MT connector	810517921-B	2, 4, 8, and 12 cores
Analog out plug	955-230002662	

AQ2200-215 Sensor Module

Model	Suffix Code	Description
735125		High power sensor
Connector adapter	-NON	No connector adapter
	-FCC	AQ9335C (FC) connector adapter with a light shielding cap
	-SCC	AQ9335C (SC) connector adapter with a light shielding cap
	-STC	AQ9335C (ST) connector adapter with a light shielding cap
	-LCC	AQ9335C (LC) connector adapter with a dust protection cap
	-MUC	AQ9335C (MU) connector adapter with a dust protection cap

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model or Part No.	Notes
AQ9335C (FC) connector adapter	810518909-FCC	FC connector
AQ9335C (SC) connector adapter	810518910-SCC	SC connector
AQ9335C (ST) connector adapter	810518911-STC	ST connector
AQ9335C (LC) connector adapter	M3407JD	LC connector with a dust protection cap
AQ9335C (MU) connector adapter	M3407JE	MU connector with a dust protection cap
Light shielding cap (FC)	810518912-FCC	Light shielding cap for an FC connector
Light shielding cap (SC)	810518913-SCC	Light shielding cap for an SC connector
Light shielding cap (ST)	810518914-STC	Light shielding cap for an ST connector
Dust protection cap (LC)	M3407HD	Dust protection cap for an LC connector
Dust protection cap (MU)	M3407HE	Dust protection cap for an MU connector

AQ2200-221 Sensor Module

Model	Suffix Code	Description
735122		Two-channel, long-wavelength sensor
Connector adapter	-NON	No connector adapter
	-FCC	AQ9335C (FC) connector adapter with a light shielding cap
	-SCC	AQ9335C (SC) connector adapter with a light shielding cap
	-STC	AQ9335C (ST) connector adapter with a light shielding cap
	-LCC	AQ9335C (LC) connector adapter with a dust protection cap
	-MUC	AQ9335C (MU) connector adapter with a dust protection cap

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Model or Part No.	Notes
AQ9335C (FC) connector adapter	810518909-FCC	FC connector
AQ9335C (SC) connector adapter	810518910-SCC	SC connector
AQ9335C (ST) connector adapter	810518911-STC	ST connector
AQ9335C (LC) connector adapter	M3407JD	LC connector with a dust protection cap
AQ9335C (MU) connector adapter	M3407JE	MU connector with a dust protection cap
Light shielding cap (FC)	810518912-FCC	Light shielding cap for an FC connector
Light shielding cap (SC)	810518913-SCC	Light shielding cap for an SC connector
Light shielding cap (ST)	810518914-STC	Light shielding cap for an ST connector
Dust protection cap (LC)	M3407HD	Dust protection cap for an LC connector
Dust protection cap (MU)	M3407HE	Dust protection cap for an MU connector

AQ2200-271 ORL Module

Model	Suffix Code	Description
735185		
Optical fiber	-SA	SMF (10/125)

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

Optional Accessories

The following optional accessories are available for purchase separately.

Product Name	Part No.	Notes
ORL master cord	955-300001169	FC connector
ORL master cord	955-300001170	SC connector
ORL master cord	955-300900506	Open

AQ2200-311 ATTN Module

Model	Suffix Code	Description
810518915		
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector
	-FCA	FC/Angled PC connector
	-SCA	SC/Angled PC connector
Monitor port option	/MON	Monitor port included

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-311A ATTN Module

Model	Suffix Code	Description
735131		
Optical fiber	-SA	SMF (10/125)
	-G6	MMF (62.5/125)
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector
Monitor port option	/MON	Monitor port included

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-331 ATTN Module

Model	Suffix Code	Description
735133		Built-in optical power meter
Optical fiber	-SA	SMF (10/125)
	-G6	MMF (62.5/125)
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-411 OSW Module

Model	Suffix Code	Description
735141		1 × 4 or 1 × 8
Port configuration	-04	1 × 4
	-08	1 × 8
Optical fiber	-SA	SMF (10/125)
	-G6	MMF (62.5/125)
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-412 OSW Module

Model	Suffix Code	Description
735143		1 × 16
Port configuration	-16	1 × 16
Optical fiber	-SA	SMF (10/125)
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-421 OSW Module

Model	Suffix Code	Description
735142		1 × 2 or 2 × 2
Port configuration	-21	1 × 2
	-22	2 × 2
Optical fiber	-SA	SMF (10/125)
	-G6	MMF (62.5/125)
Optical connector	-FCC	FC/PC connector
	-SCC	SC/PC connector

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument

AQ2200-601 10 Gbit/s BERT Module

Model	Suffix Code	Description
810518801		
Options	/M	PC software for creating 64 Mbit program patterns
	/P1	PC software for creating SDH/SONET frame patterns

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument
Protective cap	-	5	Protective caps are already attached to the input terminals.
Terminator for circuit protection	-	6	Terminators are already attached to the output terminals.

AQ2200-621 10 Gbit/s Optical modulator

Model	Suffix Code	Description
810518802		1.55 μm
Crystal orientation of the LN modulator	-A	X-cut
	-B	Z-cut
Optical connector	-S	SC connector
	-F	FC connector
Cable	/P	PMF (FC-SC) for 1.5 μm
	/U	U-link coaxial cable

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument
Protective cap	-	2	Protective caps are already attached to the optical signal terminals.
Terminator for circuit protection	-	1	Terminator is already attached to the electrical terminal.

AQ2200-622 10 Gbit/s Optical Modulator

Model	Suffix Code	Description
810518804		1.31 μm
Crystal orientation of the LN modulator	-A	X-cut
	-B	Z-cut
Optical connector	-S	SC connector
	-F	FC connector
Cable	/P	PMF (FC-SC) for 1.3 μm
	/U	U-link coaxial cable

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument
Protective cap	-	2	Protective caps are already attached to the optical signal terminals.
Terminator for circuit protection	-	1	Terminator is already attached to the electrical terminal.

AQ2200-631 10 Gbit/s Optical Receiver

Model	Suffix Code	Description
810518803		1.31/1.55 μm
Optical connector	-S	SC connector
	-F	FC connector
Cable	/U	U-link coaxial cable

Accessories

The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument
Protective cap	-	1	Protective cap is already attached to the optical signal terminal.
Terminator for circuit protection	-	1	Terminator is already attached to the electrical terminal.

AQ2200-641 XFP Interface Module

Model	Suffix Code	Description
735161		

Accessories

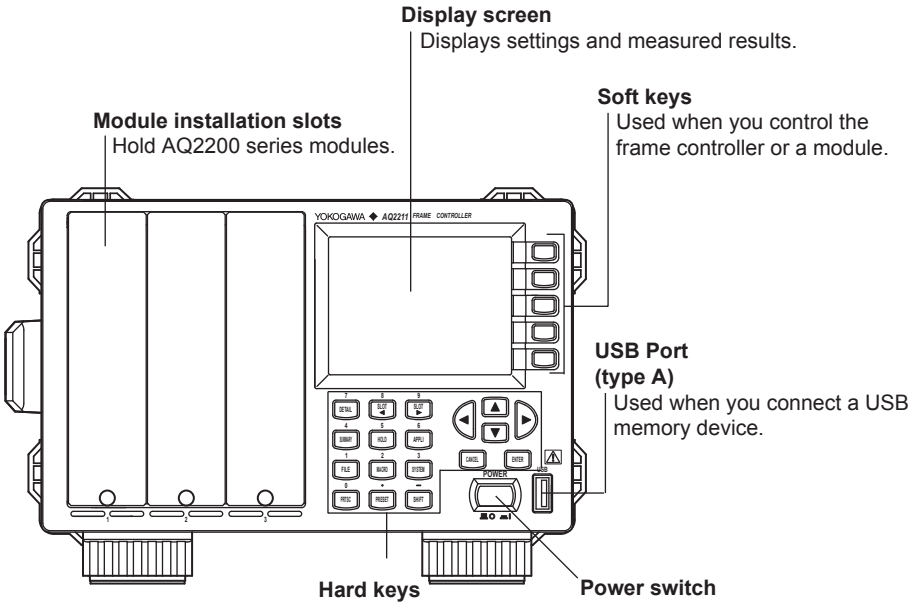
The instrument is shipped with the following accessories.

Product Name	Model or Part No.	Quantity	Notes
User's manual	IM 810518901-04E	1	Read before using the instrument
Protective cap	-	3	Protective caps are already attached to the input terminals.
Terminator for circuit protection	-	2	Terminators are already attached to the output terminals.

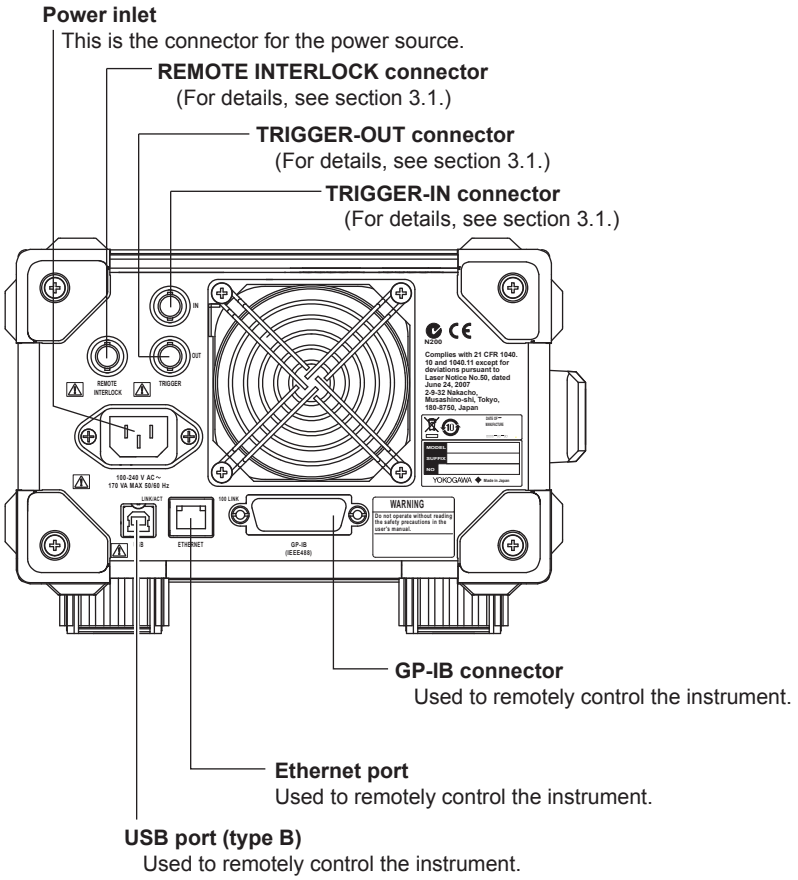
1.1 Frame Controller

Three-Slot Type

Front

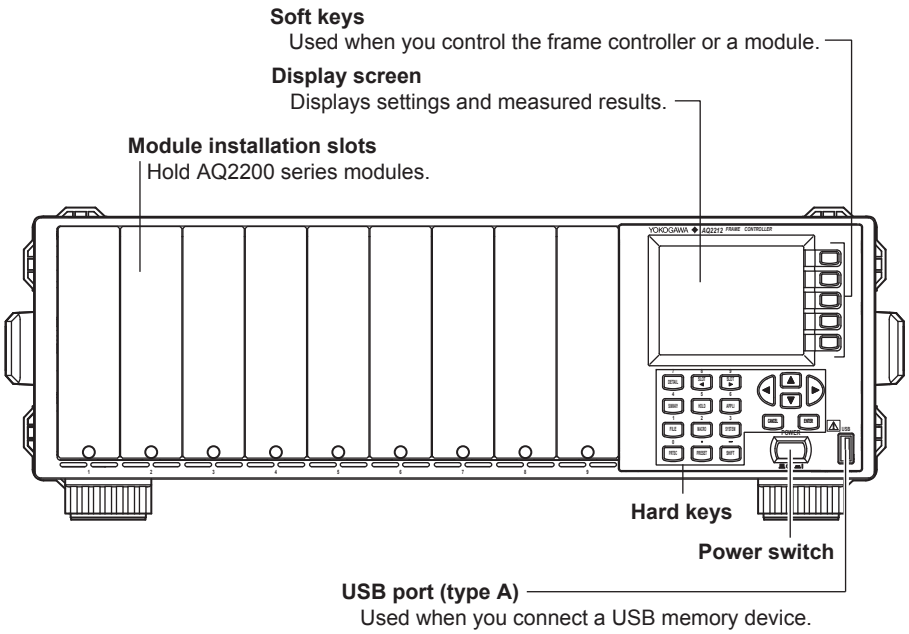

Display screen
Displays settings and measured results.
Soft keys
Used when you control the frame controller or a module.
Module installation slots
Hold AQ2200 series modules.
USB Port (type A)
Used when you connect a USB memory device.
Hard keys
Power switch

Back

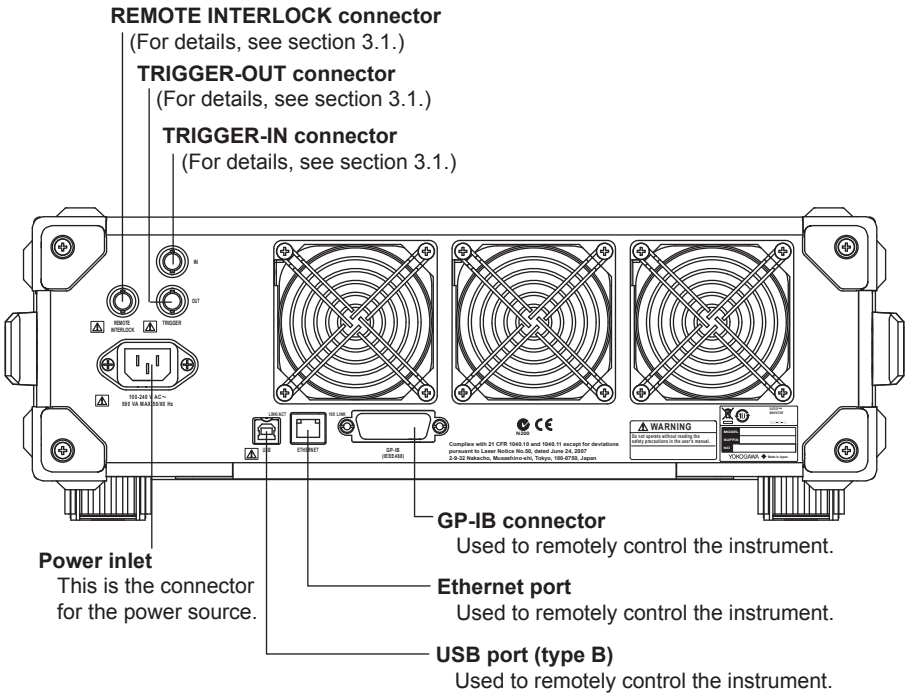

Power inlet
This is the connector for the power source.
REMOTE INTERLOCK connector
(For details, see section 3.1.)
TRIGGER-OUT connector
(For details, see section 3.1.)
TRIGGER-IN connector
(For details, see section 3.1.)
GP-IB connector
Used to remotely control the instrument.
Ethernet port
Used to remotely control the instrument.
USB port (type B)
Used to remotely control the instrument.

Nine-Slot Type

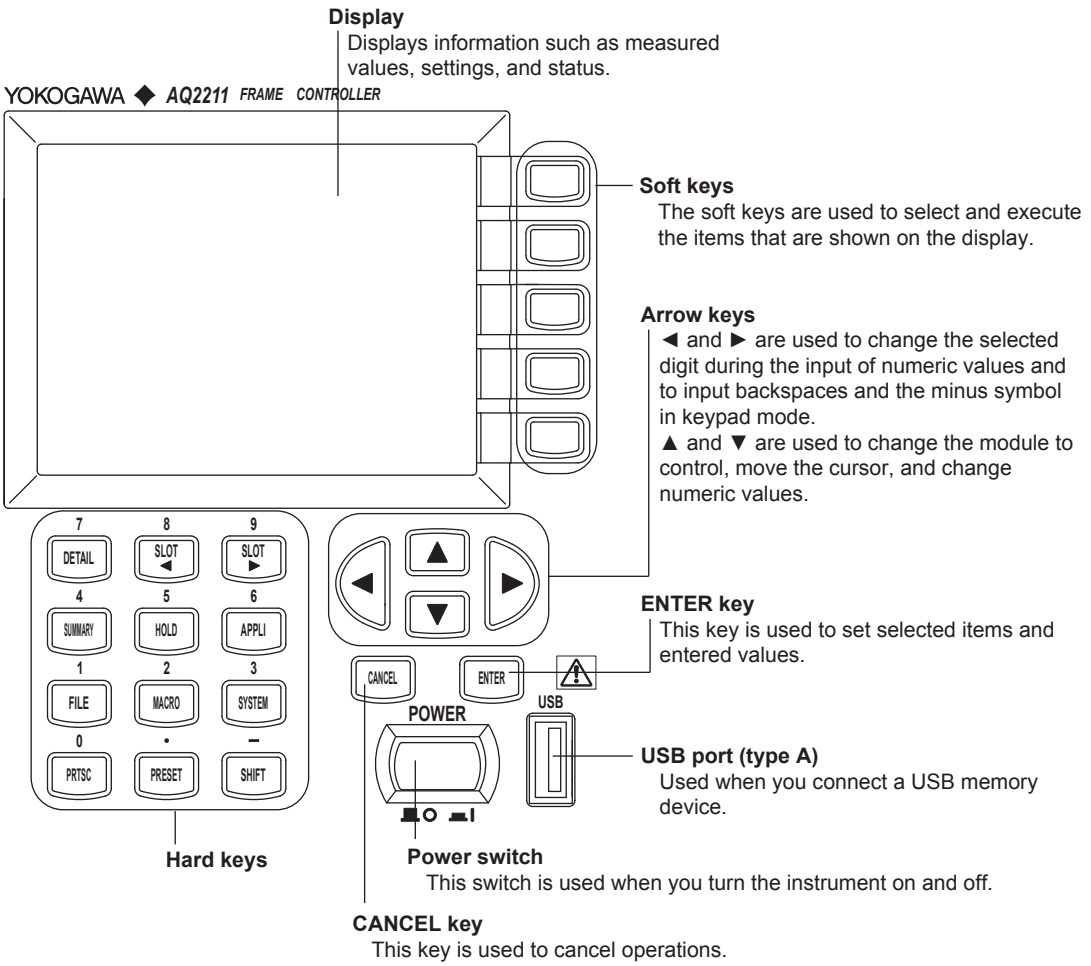
Front


Soft keys
Used when you control the frame controller or a module.
Display screen
Displays settings and measured results.
Module installation slots
Hold AQ2200 series modules.
Hard keys
Power switch
USB port (type A)
Used when you connect a USB memory device.

Back


REMOTE INTERLOCK connector
(For details, see section 3.1.)
TRIGGER-OUT connector
(For details, see section 3.1.)
TRIGGER-IN connector
(For details, see section 3.1.)
GP-IB connector
Used to remotely control the instrument.
Power inlet
This is the connector for the power source.
Ethernet port
Used to remotely control the instrument.
USB port (type B)
Used to remotely control the instrument.

Display and Key Operation Console


Display
Displays information such as measured values, settings, and status.
YOKOGAWA ◆ AQ2211 FRAME CONTROLLER
Soft keys
The soft keys are used to select and execute the items that are shown on the display.
Arrow keys
◄ and ► are used to change the selected digit during the input of numeric values and to input backspaces and the minus symbol in keypad mode.
▲ and ▼ are used to change the module to control, move the cursor, and change numeric values.
ENTER key
This key is used to set selected items and entered values.
USB port (type A)
Used when you connect a USB memory device.
7 DETAIL
8 SLOT ◄
9 SLOT ►
4 SUMMARY
5 HOLD
6 APPLI
1 FILE
2 MACRO
3 SYSTEM
0 PRTSC
• PRESET
– SHIFT
CANCEL
ENTER
POWER
USB
Hard keys
Power switch
This switch is used when you turn the instrument on and off.
CANCEL key
This key is used to cancel operations.

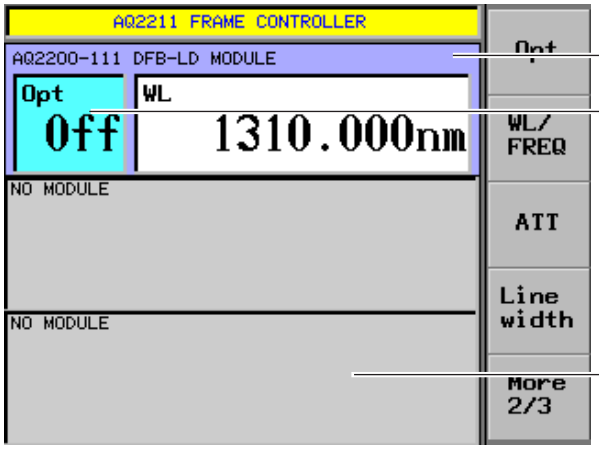
Hard Keys

Key Name	Description
DETAIL	Switches the displayed screen to the DETAIL screen. This hard key is “7” in keypad mode.
SLOT ◄	Switches the module to control. Each time you press this hard key, you switch the module that is being controlled to the module in the previous slot. This hard key is “8” in keypad mode.
SLOT ►	Switches the module to control. Each time you press this hard key, you switch the module that is being controlled to the module in the next slot. This hard key is “9” in keypad mode.
SUMMARY	Switches the displayed screen to the SUMMARY screen. This hard key is “4” in keypad mode.
HOLD	Stops updating the screen display. If you press this hard key again or if you press another hard key, the screen display will start updating again. This hard key is “5” in keypad mode.
APPLI	Displays the APPLICATION screen. This hard key is “6” in keypad mode.
FILE	Displays the FILE LIST screen. This hard key is “1” in keypad mode.
MACRO	Displays the MACRO screen. This hard key is “2” in keypad mode.
SYSTEM	Displays the SYSTEM screen. This hard key is “3” in keypad mode.
PRTSC	Saves a capture of the displayed screen to a file. This hard key is “0” in keypad mode.
PRESET	Initializes the parameters of the frame and the installed modules. This hard key is “.” in keypad mode.
SHIFT	Extension key. This hard key is “-” in keypad mode.

SUMMARY Screen

The SUMMARY screen displays the information from all the installed modules at once.
You can view the main parameters, and confirm and change all the parameters.

- Current module: Module with a blue background.
  You can change this module's parameters. The parameters that you can change are displayed as soft keys.
- Current parameter: Parameter with a light blue background.

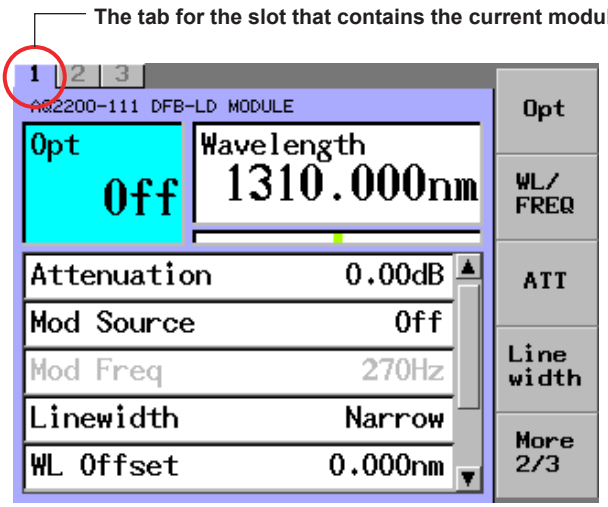


Note

Error No. 1014 may appear on this screen immediately after unit start up.
This error shows that, due to a discrepancy between the release version of the firmware installed in the frame controller and the firmware installed in the module, there is a possibility that some operations may not work properly.
Please update the firmware if this error appears.

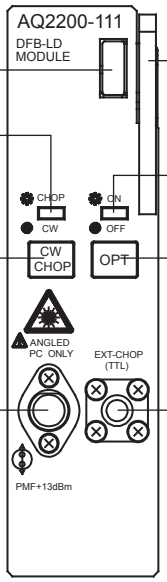
DETAIL Screen

The DETAIL screen displays the detailed information about the selected module (the current module).
You can view, confirm, and change all the current-module parameters.



1.2 Light Source Modules

AQ2200-111 DFB-LD Module



Lock lever release button
Releases the lock lever.

Modulation indication lamp
The lamp is lit when the laser output modulation is set to CHOP.

CW/CHOP key
Switches the laser output modulation.
When set to CHOP, modulation is performed at the current frequency.

Laser output
Transmits the laser beam.

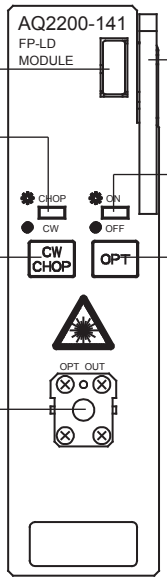
Lock lever
Used when installing and uninstalling the module.

Laser output indication lamp
The lamp is lit when the laser output is on.

OPT key
Turns the laser output on and off.

External modulation terminal
A modulation signal is applied to this terminal.
(On models with the /MODS or /MODC option.)

AQ2200-141 FP-LD Module



Lock lever release button
Releases the lock lever.

Modulation indication lamp
The lamp is lit when the laser output modulation is set to CHOP.

CW/CHOP key
Switches the laser output modulation.
When set to CHOP, modulation is performed at the current frequency.

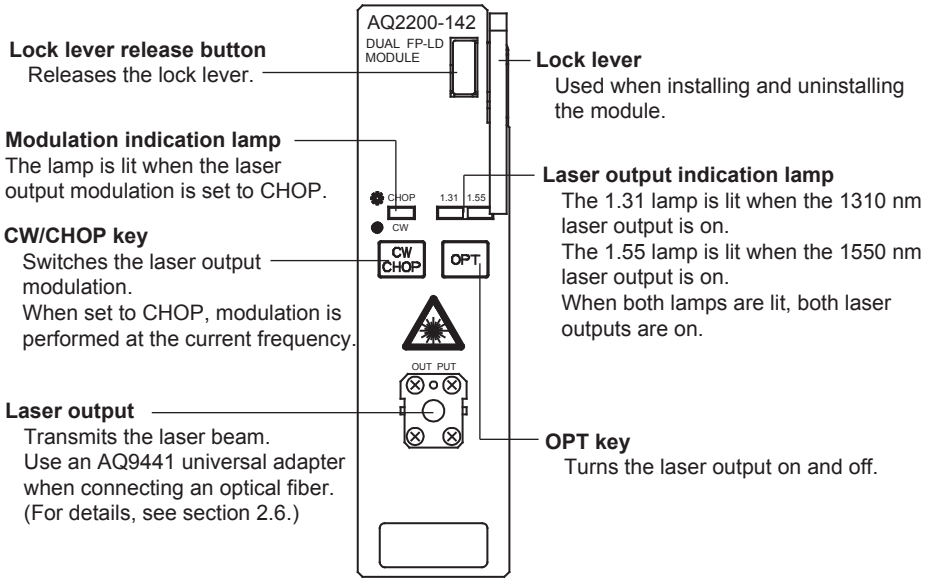
Laser output
Transmits the laser beam.
Use an AQ9441 universal adapter when connecting an optical fiber.
(For details, see section 2.6.)

Lock lever
Used when installing and uninstalling the module.

Laser output indication lamp
The lamp is lit when the laser output is on.

OPT key
Turns the laser output on and off.

AQ2200-142 DUAL FP-LD Module



Lock lever release button
Releases the lock lever.

Modulation indication lamp
The lamp is lit when the laser output modulation is set to CHOP.

CW/CHOP key
Switches the laser output modulation.
When set to CHOP, modulation is performed at the current frequency.

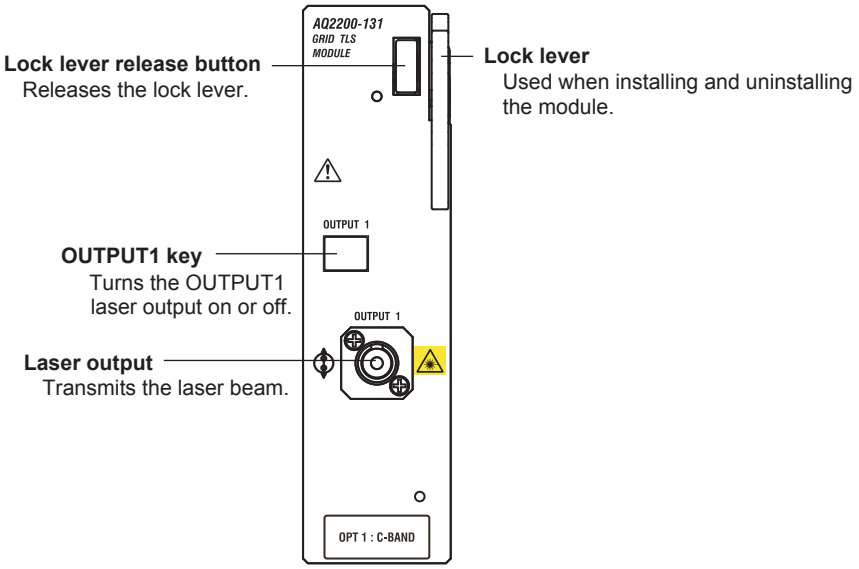
Laser output
Transmits the laser beam.
Use an AQ9441 universal adapter when connecting an optical fiber. (For details, see section 2.6.)

Lock lever
Used when installing and uninstalling the module.

Laser output indication lamp
The 1.31 lamp is lit when the 1310 nm laser output is on.
The 1.55 lamp is lit when the 1550 nm laser output is on.
When both lamps are lit, both laser outputs are on.

OPT key
Turns the laser output on and off.

AQ2200-131 Grid TLS Module



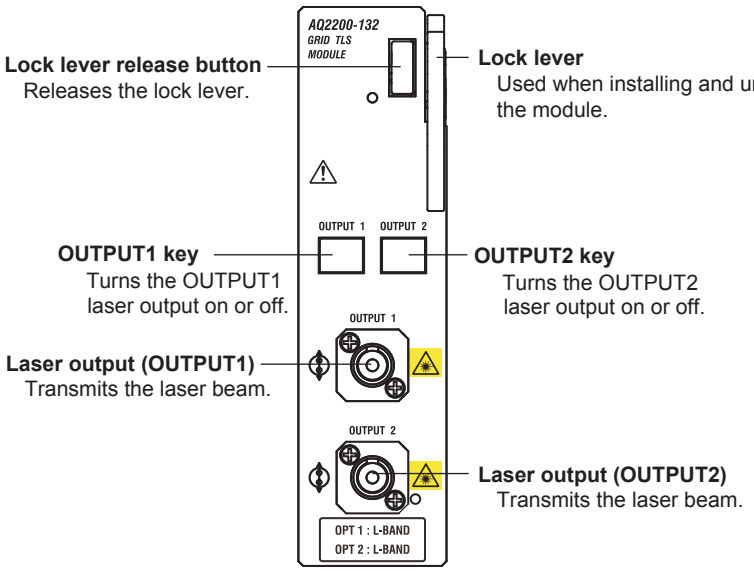
Lock lever release button
Releases the lock lever.

OUTPUT1 key
Turns the OUTPUT1 laser output on or off.

Laser output
Transmits the laser beam.

Lock lever
Used when installing and uninstalling the module.

AQ2200-132 Grid TLS Module



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

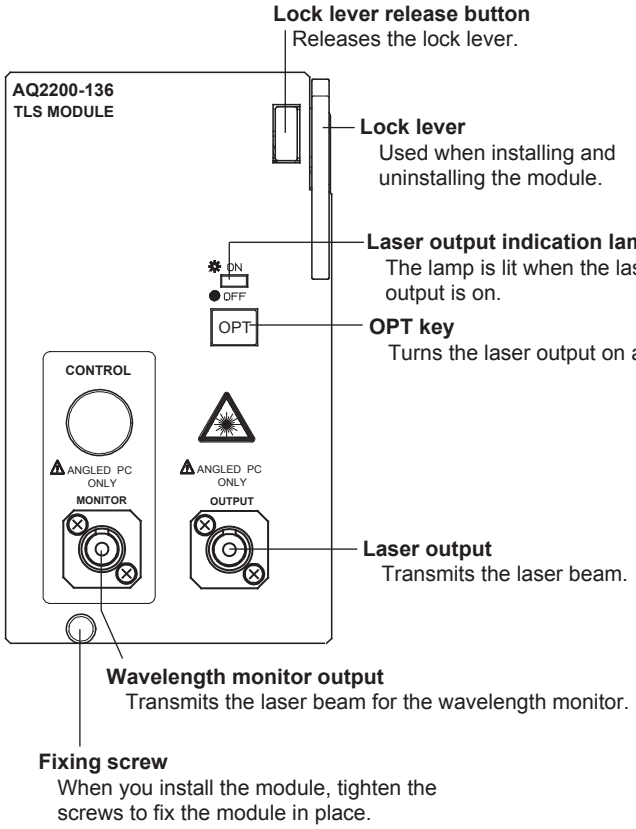
OUTPUT1 key
Turns the OUTPUT1 laser output on or off.

OUTPUT2 key
Turns the OUTPUT2 laser output on or off.

Laser output (OUTPUT1)
Transmits the laser beam.

Laser output (OUTPUT2)
Transmits the laser beam.

AQ2200-136 TLS Module



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Laser output indication lamp
The lamp is lit when the laser output is on.

OPT key
Turns the laser output on and off.

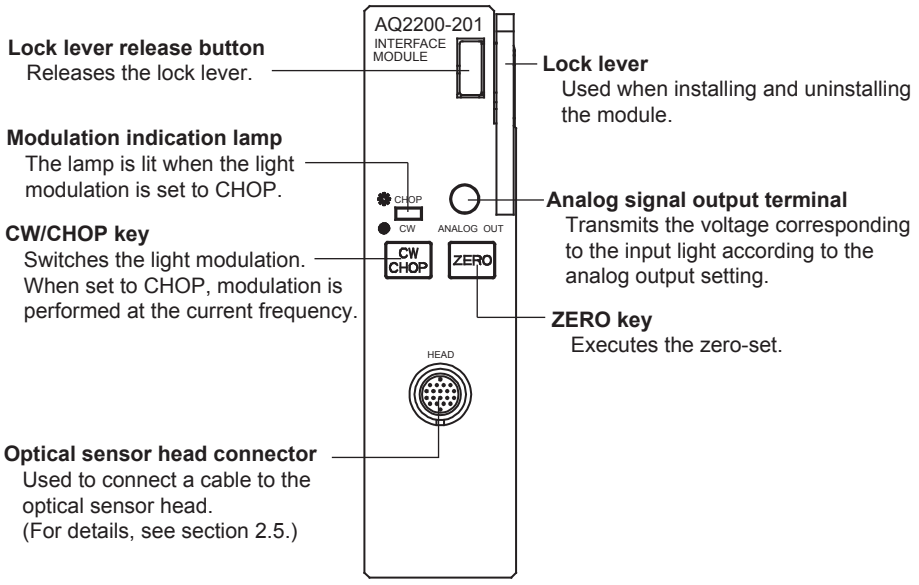
Laser output
Transmits the laser beam.

Wavelength monitor output
Transmits the laser beam for the wavelength monitor.

Fixing screw
When you install the module, tighten the screws to fix the module in place.

1.3 Optical Sensor Modules

AQ2200-201 Interface Module



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Modulation indication lamp
The lamp is lit when the light modulation is set to CHOP.

Analog signal output terminal
Transmits the voltage corresponding to the input light according to the analog output setting.

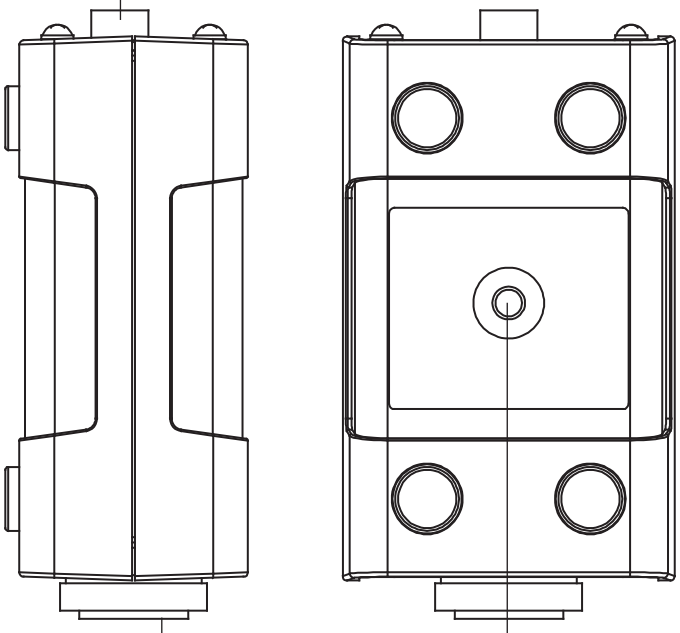
CW/CHOP key
Switches the light modulation. When set to CHOP, modulation is performed at the current frequency.

ZERO key
Executes the zero-set.

Optical sensor head connector
Used to connect a cable to the optical sensor head.
(For details, see section 2.5.)

AQ2200-231/-241 Optical Sensor Head

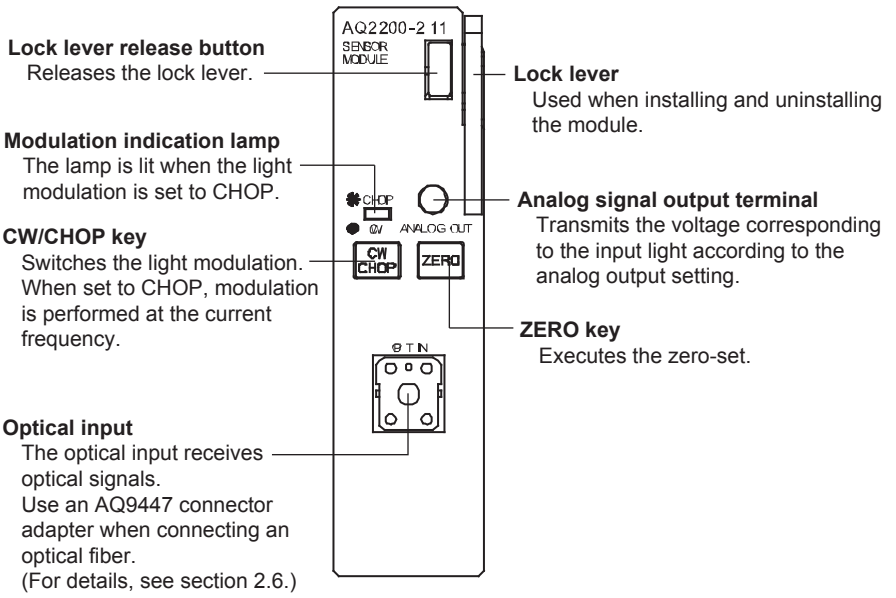
Interface module connector
You can use a cable to connect the optical sensor head to an AQ2200-201 interface module.



Optical input
The optical input receives optical signals. Use an AQ9335C connector adapter when connecting an optical fiber.
(For details, see section 2.6.)

Installation groove
The installation groove is used to fix the unit in place.
You can use 5 mm M6 screws.

AQ2200-211 Sensor Module (Highly sensitive type)



Lock lever release button
Releases the lock lever.

Modulation indication lamp
The lamp is lit when the light modulation is set to CHOP.

CW/CHOP key
Switches the light modulation. When set to CHOP, modulation is performed at the current frequency.

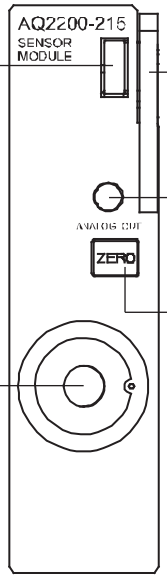
Optical input
The optical input receives optical signals.
Use an AQ9447 connector adapter when connecting an optical fiber.
(For details, see section 2.6.)

Lock lever
Used when installing and uninstalling the module.

Analog signal output terminal
Transmits the voltage corresponding to the input light according to the analog output setting.

ZERO key
Executes the zero-set.

AQ2200-215 Sensor Module (High power type)



Lock lever release button
Releases the lock lever.

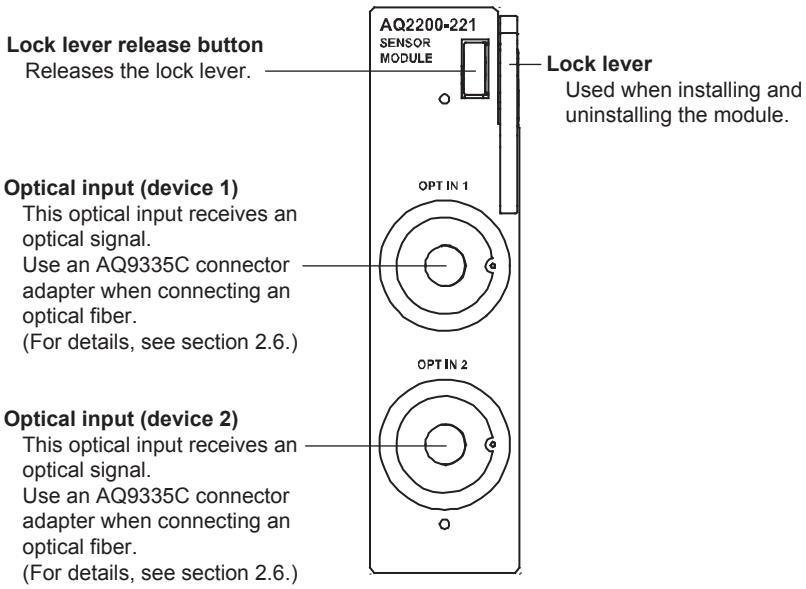
Optical input
The optical input receives optical signals.
Use an AQ9335C connector adapter when connecting an optical fiber.
(For details, see section 2.6.)

Lock lever
Used when installing and uninstalling the modul

Analog signal output terminal
Transmits the voltage corresponding to the input light according to the analog output setting.

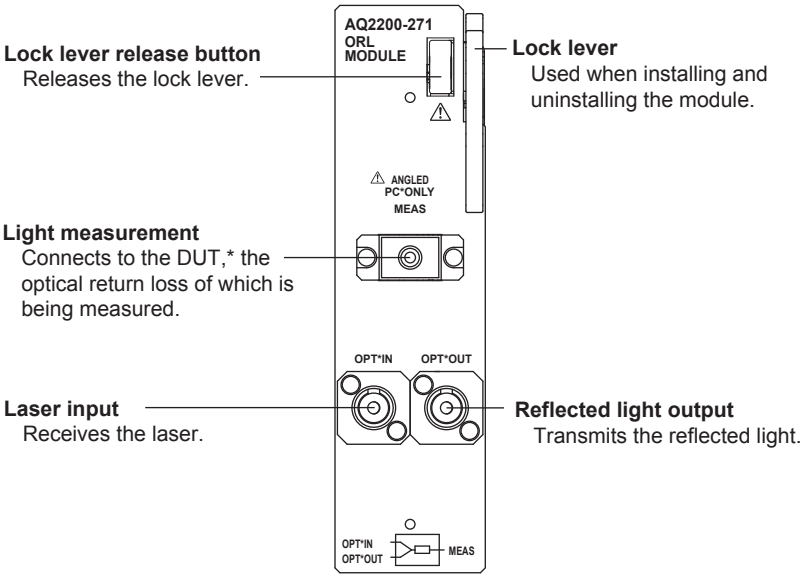
ZERO key
Executes the zero-set.

AQ2200-221 Sensor Module (Dual)


Lock lever release button
Releases the lock lever.
Optical input (device 1)
This optical input receives an optical signal.
Use an AQ9335C connector adapter when connecting an optical fiber.
(For details, see section 2.6.)
Optical input (device 2)
This optical input receives an optical signal.
Use an AQ9335C connector adapter when connecting an optical fiber.
(For details, see section 2.6.)
AQ2200-221
SENSOR
MODULE
OPT IN 1
OPT IN 2
Lock lever
Used when installing and uninstalling the module.

1.4 ORL Module

AQ2200-271 ORL Module



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Light measurement
Connects to the DUT,* the optical return loss of which is being measured.

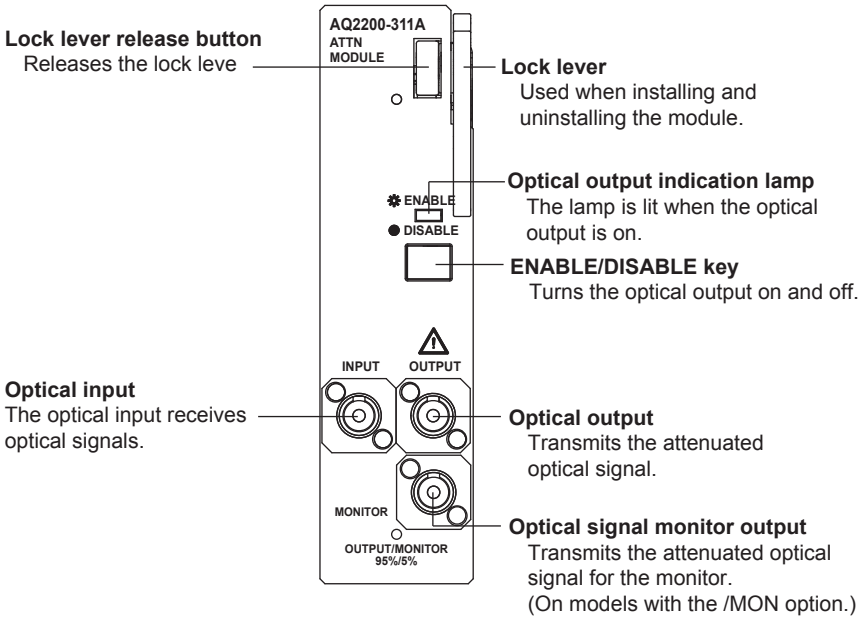
Laser input
Receives the laser.

Reflected light output
Transmits the reflected light.

* DUT stands for device under test.

1.5 Attenuator Modules

AQ2200-311A ATTN Module (Supports SMF and MMF)



Lock lever release button
Releases the lock leve

Lock lever
Used when installing and uninstalling the module.

Optical output indication lamp
The lamp is lit when the optical output is on.

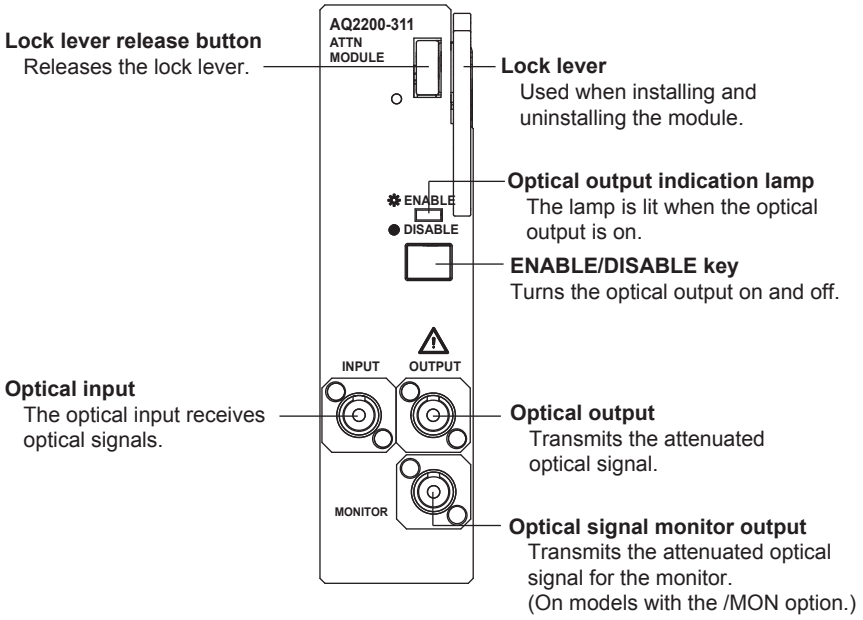
ENABLE/DISABLE key
Turns the optical output on and off.

Optical input
The optical input receives optical signals.

Optical output
Transmits the attenuated optical signal.

Optical signal monitor output
Transmits the attenuated optical signal for the monitor.
(On models with the /MON option.)

AQ2200-311 ATTN Module



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Optical output indication lamp
The lamp is lit when the optical output is on.

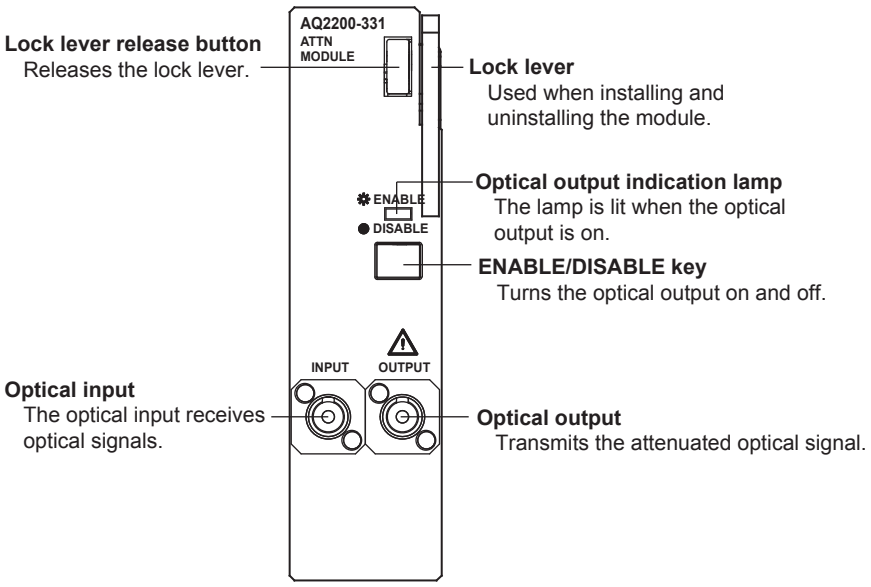
ENABLE/DISABLE key
Turns the optical output on and off.

Optical input
The optical input receives optical signals.

Optical output
Transmits the attenuated optical signal.

Optical signal monitor output
Transmits the attenuated optical signal for the monitor.
(On models with the /MON option.)

AQ2200-331 ATTN Module (With power monitor)



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Optical output indication lamp
The lamp is lit when the optical output is on.

ENABLE/DISABLE key
Turns the optical output on and off.

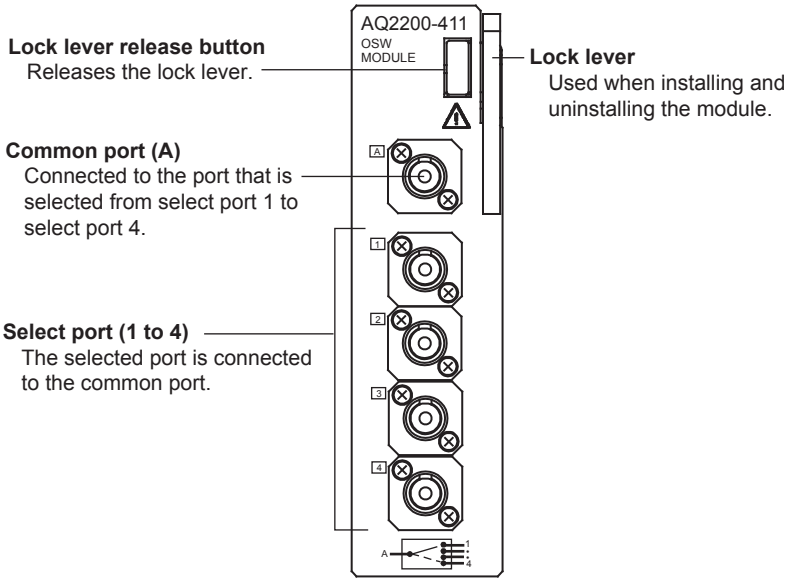
Optical input
The optical input receives optical signals.

Optical output
Transmits the attenuated optical signal.

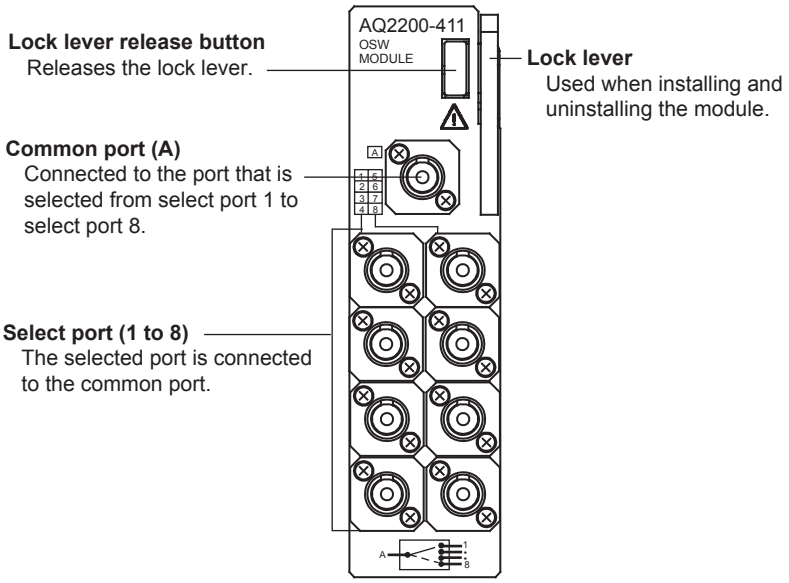
1.6 Optical Switch Modules

AQ2200-411 OSW Module

1 × 4 Type

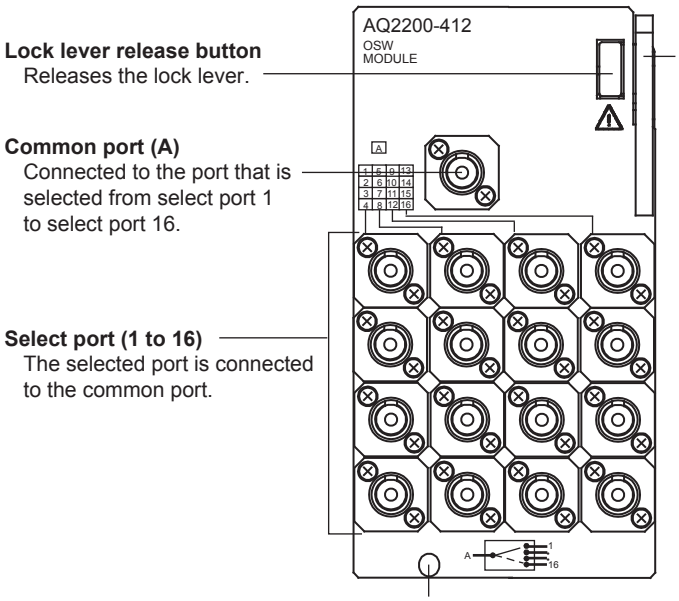


1 × 8 Type



AQ2200-412 OSW Module

1 × 16 Type



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

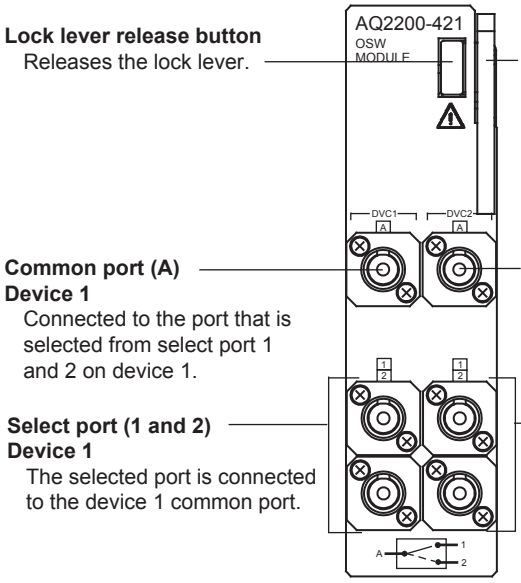
Common port (A)
Connected to the port that is selected from select port 1 to select port 16.

Select port (1 to 16)
The selected port is connected to the common port.

Fixing screw
When you install the module, tighten the screws to fix the module in place

AQ2200-421 OSW Module

1 × 2 Type



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Common port (A)
Device 1
Connected to the port that is selected from select port 1 and 2 on device 1.

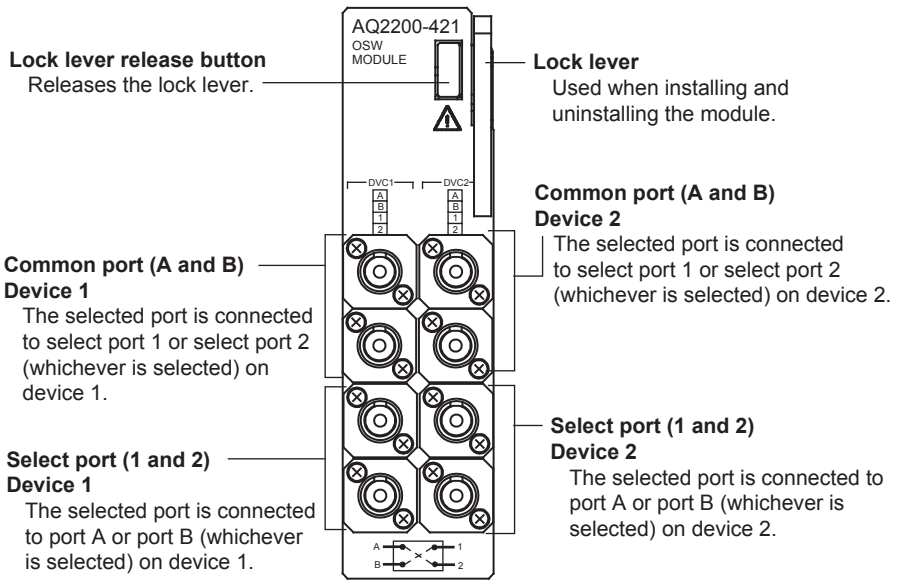
Common port (A)
Device 2
Connected to the port that is selected from select port 1 and 2 on device 2.

Select port (1 and 2)
Device 1
The selected port is connected to the device 1 common port.

Select port (1 and 2)
Device 2
The selected port is connected to the device 2 common port.

AQ2200-421 OSW Module

2 × 2 Type



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Common port (A and B) Device 2
The selected port is connected to select port 1 or select port 2 (whichever is selected) on device 2.

Common port (A and B) Device 1
The selected port is connected to select port 1 or select port 2 (whichever is selected) on device 1.

Select port (1 and 2) Device 2
The selected port is connected to port A or port B (whichever is selected) on device 2.

Select port (1 and 2) Device 1
The selected port is connected to port A or port B (whichever is selected) on device 1.

1.7 BERT Module

AQ2200-601 10 Gbit/s BERT Module

Signal output indication lamp
This lamp shows the status of the PPG signal output.The lamp is lit when the output is on.

Signal output ON/OFF key
Turns all of the PPG output terminals on or off at once. Each time this key is pressed, signal output switches between on and off.

Data output terminal (to the optical modulator)
Non-inverted data output terminal. Used when this module is combined with an optical modulator module.

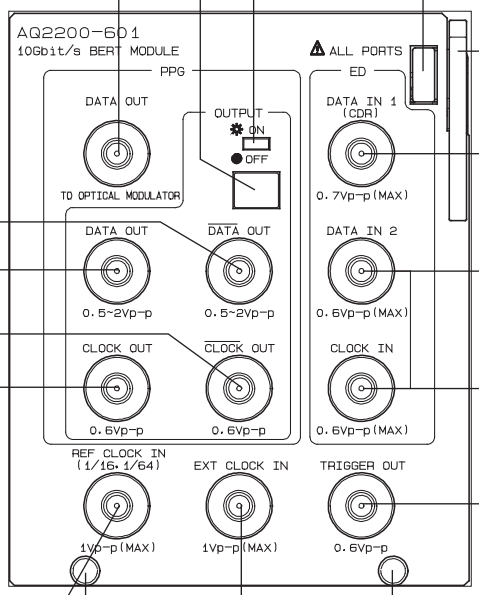
Inverted data output terminal
When output is on, this terminal transmits the 10 Gbit/s inverted data.

Non-inverted data output terminal
When output is on, this terminal transmits the 10 Gbit/s non-inverted data.

Inverted clock signal output terminal
Transmits the 10 GHz inverted clock signal. When output is on, this terminal transmits the inverted clock signal of the 10 GHz band.

Non-inverted clock signal output terminal
Transmits the 10 GHz non-inverted clock signal. When output is on, this terminal transmits the non-inverted clock signal of the 10 GHz band.

External synchronization signal input terminal
If you want to synchronize the BERT module with an external clock signal and have the module generate a PPG signal, without using the internal SG, apply a reference signal that has a frequency that is 1/16 or 1/64 of the 10 Gbit/s rate to this terminal. This clock is used not only for the PPG, but also for the clock signal to operate the CDR function of the ED.



Fixing screw

Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Data input 1 terminal
ED data input terminal. Because this terminal has a built-in CDR (clock and data recovery), it does not require clock input.

Data input 2 terminal
ED data input terminal. This terminal requires a clock signal to be applied to the clock signal input terminal.

Clock signal input terminal
ED clock signal input terminal. When you apply a signal to the data input 2 terminal, apply a clock signal to the clock signal input terminal. Adjust the phase by using an instrument such as an external phase shifter.

Trigger signal output terminal
Transmits one of the following trigger signals.
(For details, see section 1.6 in IM 735101-03E.)
- Clock trigger (1/16 or 1/64)
- Pattern trigger
- Error trigger

External clock signal input terminal
If you want to operate the BERT module with an external clock signal at a rate of 10 Gbit/s, without using the internal SG, apply a 10 Gbit/s clock signal to this terminal. This clock is used not only for the PPG, but also for the reference clock signal to operate the CDR function of the ED.

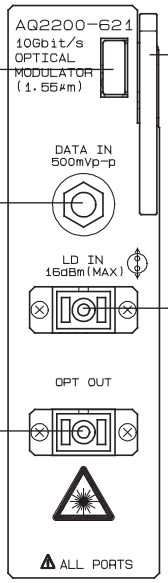
Fixing screw
When you install the module, tighten the screws to fix the module in place.

Note

- **When using the external synchronization input terminal and the data input 1 terminal:**
  If the signal applied to the ED's data input 1 terminal is not synchronized with the PPG, adjust the settings so that the frequency 16 or 64 times larger than the reference signal to be applied to the external synchronization input terminal is within ±100 ppm of the input data rate.
- **When using the external clock input terminal and the data input 1 terminal:**
  If the signal applied to the ED's data input 1 terminal is not synchronized with the PPG, adjust the settings so that the frequency 16 or 64 times larger than the reference signal to be applied to the external clock input terminal is within ±100 ppm of the input data rate.

1.8 Optical Modulator Modules

AQ2200-621 10 Gbit/s Optical Modulator (Wavelength: 1.55 μm)



Lock lever release button
Releases the lock lever.

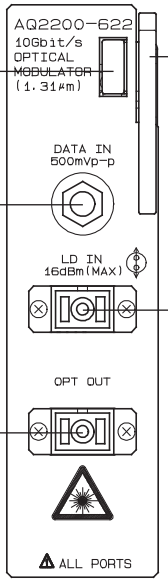
Lock lever
Used when installing and uninstalling the module.

Data input terminal
Data input terminal.
Use a U-link (/U option) or coaxial cable to connect this terminal to the DATA OUT (TO OPTICAL MODULATOR) terminal on the PPG of a BERT module.

Laser input terminal
Connects to the light source.
If you use an AQ2200-111 (PMF specifications) for the light source, connect it with a PANDA fiber (/P option). If you use any other light source, adjust the Slow axis of the polarized wave to the connector key position.

Optical output terminal
Transmits the optical signal, the light intensity of which is modulated.

AQ2200-622 10 Gbit/s Optical Modulator (Wavelength: 1.31 μm)



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Data input terminal
Data input terminal.
Use a U-link (/U option) or coaxial cable to connect this terminal to the DATA OUT (TO OPTICAL MODULATOR) terminal on the PPG of a BERT module.

Laser input terminal
Connects to the light source.
If you use an AQ2200-111 (PMF specifications) for the light source, connect it with a PANDA fiber (/P option). If you use any other light source, adjust the Slow axis of the polarized wave to the connector key position.

Optical output terminal
Transmits the optical signal, the light intensity of which is modulated.

Note

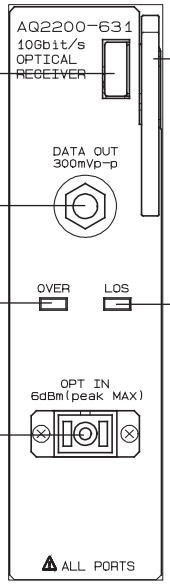
If you require a stable extinction ratio, we recommend that you warm up this module for a period of approximately 100 minutes before use.

1.9 Optical Receiver Module

AQ2200-631 10 Gbit/s Optical Receiver

CAUTION

Use an optical ATT to protect the terminal if there is a chance that the input level of the 10 Gbit/s optical signal that will be applied to the optical input terminal (OPT IN) will exceed the maximum input power (6 dBm).



Lock lever release button
Releases the lock lever.

Lock lever
Used when installing and uninstalling the module.

Data output terminal
Use a U-link (/U option) or coaxial cable to connect this terminal to the DATA IN 1 (CDR) terminal on the ED of a BERT module.

Power monitor lamp (OVER)
The average power level of the received light is monitored, and this lamp lights when the average power level is greater than the OVERLOAD level.

Power monitor lamp (LOS)
The average power level of the received light is monitored, and this lamp lights when the average power level is lower than the LOS level.

Optical input terminal
The 10 Gbit/s optical signal is applied to this terminal.

Note

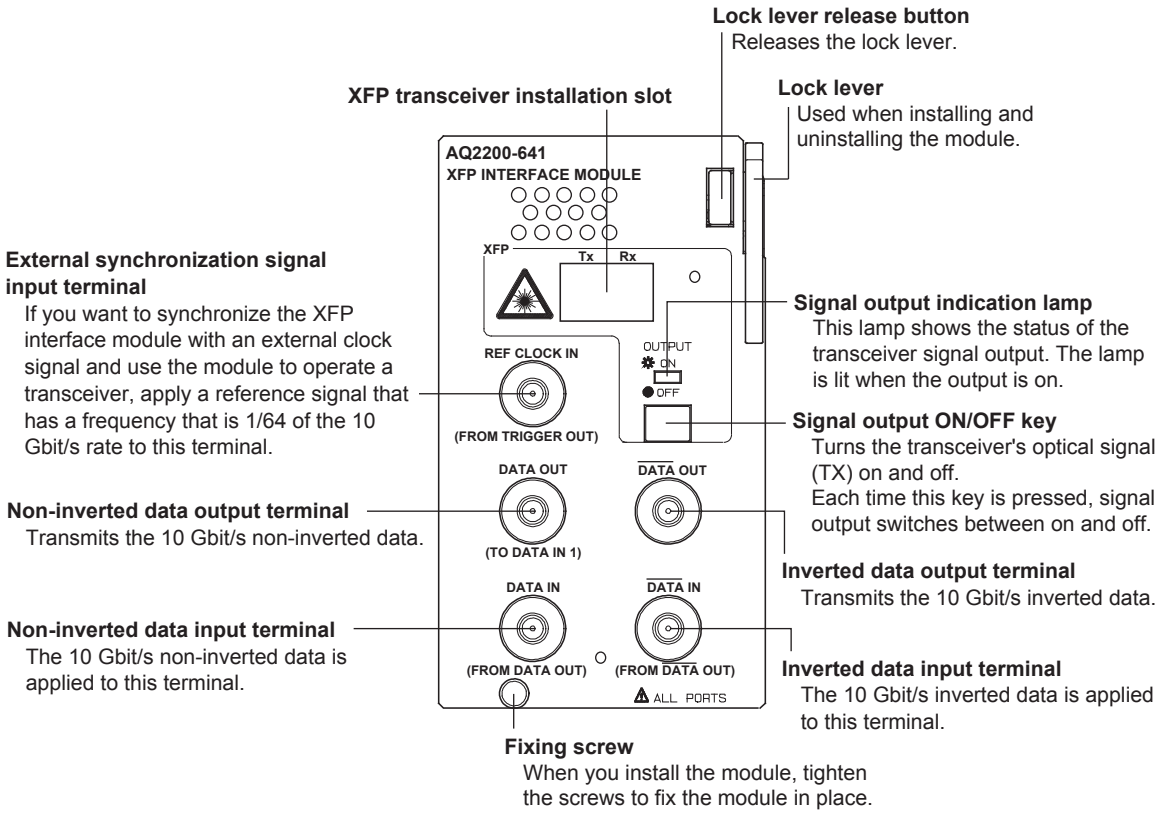
- Because the OVER and LOS lamps are used in detecting the level of the received light, there is not necessarily a bit error in the received data even if these lamps are lit.
- If you require a stable minimum sensitivity for received light, we recommend that you warm up this module for a period of approximately 30 minutes before use.

1.10 XFP Interface Module

AQ2200-641 XFP Interface Module

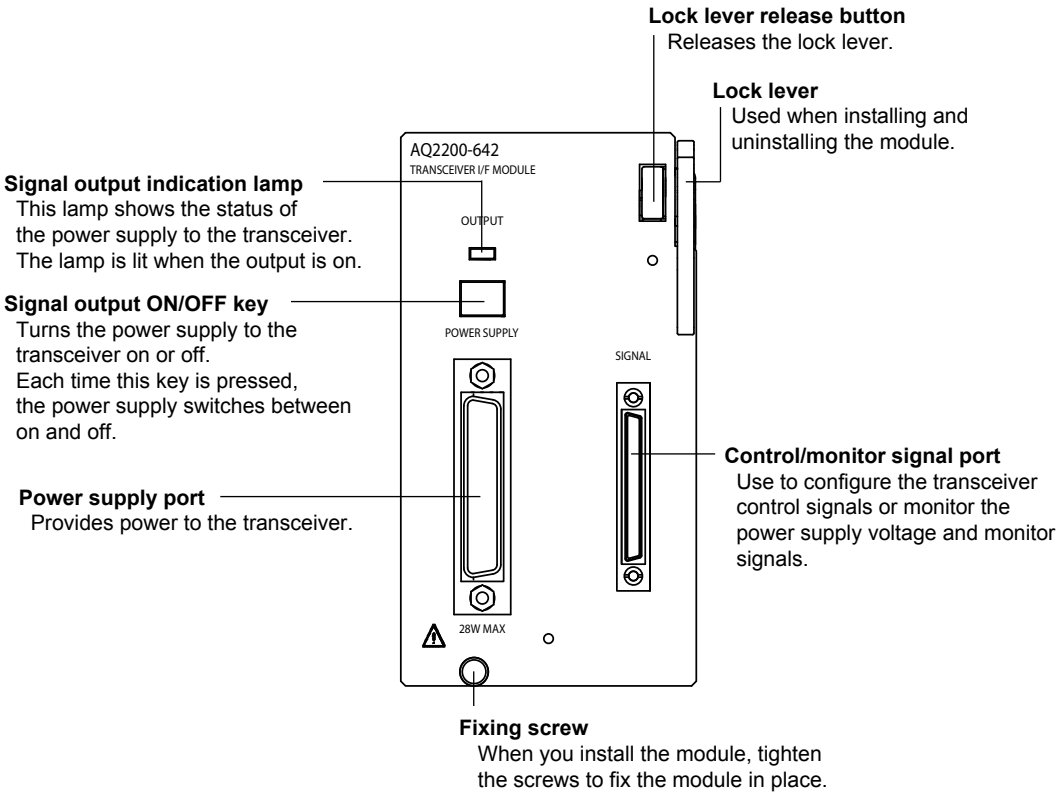
CAUTION

If an XFP transceiver is not installed, cover the DATA IN and $\overline{\text{DATA}}$ IN input terminals with the included protective caps.


Lock lever release button
Releases the lock lever.
XFP transceiver installation slot
Lock lever
Used when installing and uninstalling the module.
AQ2200-641
XFP INTERFACE MODULE
XFP
Tx
Rx
External synchronization signal input terminal
If you want to synchronize the XFP interface module with an external clock signal and use the module to operate a transceiver, apply a reference signal that has a frequency that is 1/64 of the 10 Gbit/s rate to this terminal.
REF CLOCK IN
(FROM TRIGGER OUT)
OUTPUT
ON
OFF
Signal output indication lamp
This lamp shows the status of the transceiver signal output. The lamp is lit when the output is on.
Signal output ON/OFF key
Turns the transceiver's optical signal (TX) on and off.
Each time this key is pressed, signal output switches between on and off.
DATA OUT
DATA OUT
Non-inverted data output terminal
Transmits the 10 Gbit/s non-inverted data.
(TO DATA IN 1)
Inverted data output terminal
Transmits the 10 Gbit/s inverted data.
DATA IN
DATA IN
Non-inverted data input terminal
The 10 Gbit/s non-inverted data is applied to this terminal.
(FROM DATA OUT)
(FROM DATA OUT)
ALL PORTS
Inverted data input terminal
The 10 Gbit/s inverted data is applied to this terminal.
Fixing screw
When you install the module, tighten the screws to fix the module in place.

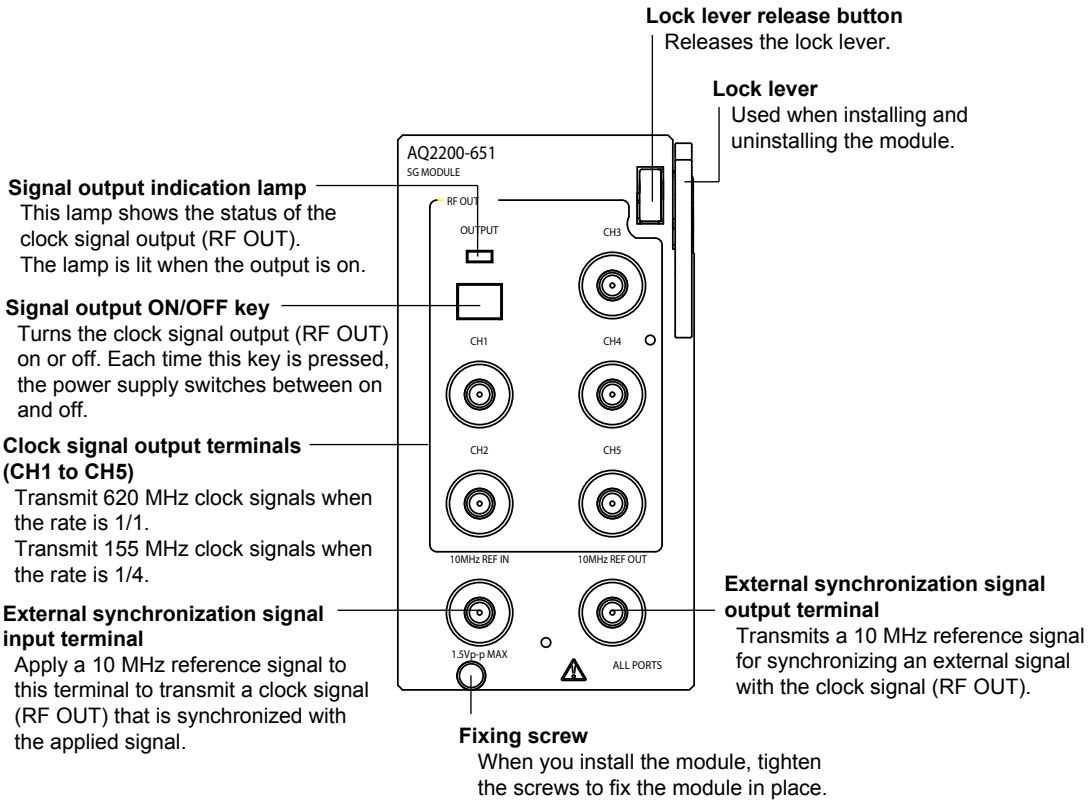
1.11 Transceiver I/F Module

AQ2200-642 Transceiver I/F Module


Lock lever release button
Releases the lock lever.
Lock lever
Used when installing and uninstalling the module.
AQ2200-642
TRANSCEIVER I/F MODULE
Signal output indication lamp
This lamp shows the status of the power supply to the transceiver. The lamp is lit when the output is on.
OUTPUT
Signal output ON/OFF key
Turns the power supply to the transceiver on or off. Each time this key is pressed, the power supply switches between on and off.
POWER SUPPLY
SIGNAL
Control/monitor signal port
Use to configure the transceiver control signals or monitor the power supply voltage and monitor signals.
Power supply port
Provides power to the transceiver.
28W MAX
Fixing screw
When you install the module, tighten the screws to fix the module in place.

1.12 SG Module

AQ2200-651 SG Module


Lock lever release button
Releases the lock lever.
Lock lever
Used when installing and uninstalling the module.
AQ2200-651
SG MODULE
RF OUT
OUTPUT
CH3
CH1
CH4
CH2
CH5
10MHz REF IN
10MHz REF OUT
1.5Vp-p MAX
ALL PORTS
Signal output indication lamp
This lamp shows the status of the clock signal output (RF OUT). The lamp is lit when the output is on.
Signal output ON/OFF key
Turns the clock signal output (RF OUT) on or off. Each time this key is pressed, the power supply switches between on and off.
Clock signal output terminals (CH1 to CH5)
Transmit 620 MHz clock signals when the rate is 1/1.
Transmit 155 MHz clock signals when the rate is 1/4.
External synchronization signal input terminal
Apply a 10 MHz reference signal to this terminal to transmit a clock signal (RF OUT) that is synchronized with the applied signal.
External synchronization signal output terminal
Transmits a 10 MHz reference signal for synchronizing an external signal with the clock signal (RF OUT).
Fixing screw
When you install the module, tighten the screws to fix the module in place.

2.1 Handling Precautions

Safety Precautions

If you are using this instrument for the first time, make sure to thoroughly read the safety precautions given on pages xiv to xvii.

Do Not Remove the Case

Do not remove the case from the frame controller. Some parts of the instrument use high voltages and are extremely dangerous. For internal inspection and adjustment, contact your nearest YOKOGAWA dealer.

Unplug If Abnormal Behavior Occurs

If you notice smoke or unusual odors coming from the instrument, immediately turn off the power and unplug the power cord. Then, contact your nearest YOKOGAWA dealer.

Do Not Damage the Power Cord

Nothing should be placed on top of the power cord, and it should be kept away from any heat sources. When removing the plug from the power outlet, do not pull on the cord. Pull from the plug. If the power cord is damaged, contact your nearest YOKOGAWA dealer. Refer to page iv for the part number when placing an order.

General Handling Precautions

Do Not Place Objects on Top of the Instrument

Never place objects such as other instruments or objects that contain water on top of the instrument. Doing so may damage the instrument.

Do Not Damage the LCD

Because the LCD is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also, the LCD should not be exposed to vibrations or shocks.

Unplug during Extended Non-Use

Unplug the power cord from the outlet.

Module Handling Precautions

- Do not expose the modules to excessive shock.
- Do not remove the module cases.
- Do not touch the metal parts of the module connectors with your hands.

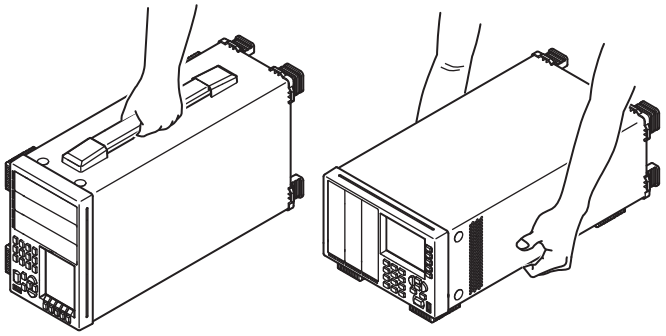
CAUTION

Do not carry the AQ2211 or AQ2212 Frame Controller while modules are installed in the instrument.

When Carrying the Instrument

Remove the power cord, all modules, and cables. When carrying the instrument, either hold the handle or hold the instrument with both hands as shown in the figure below.

AQ2211 Frame Controller



When Cleaning the Instrument

When cleaning the case or the operation panel, first remove the power cord from the outlet, and then wipe with a dry, soft, clean cloth. Do not use chemicals such as benzene or thinner. Doing so may cause discoloring and deformation.

2.2 Installing the Instrument

Installation Conditions

Install the instrument in a place that meets the following conditions.

WARNING

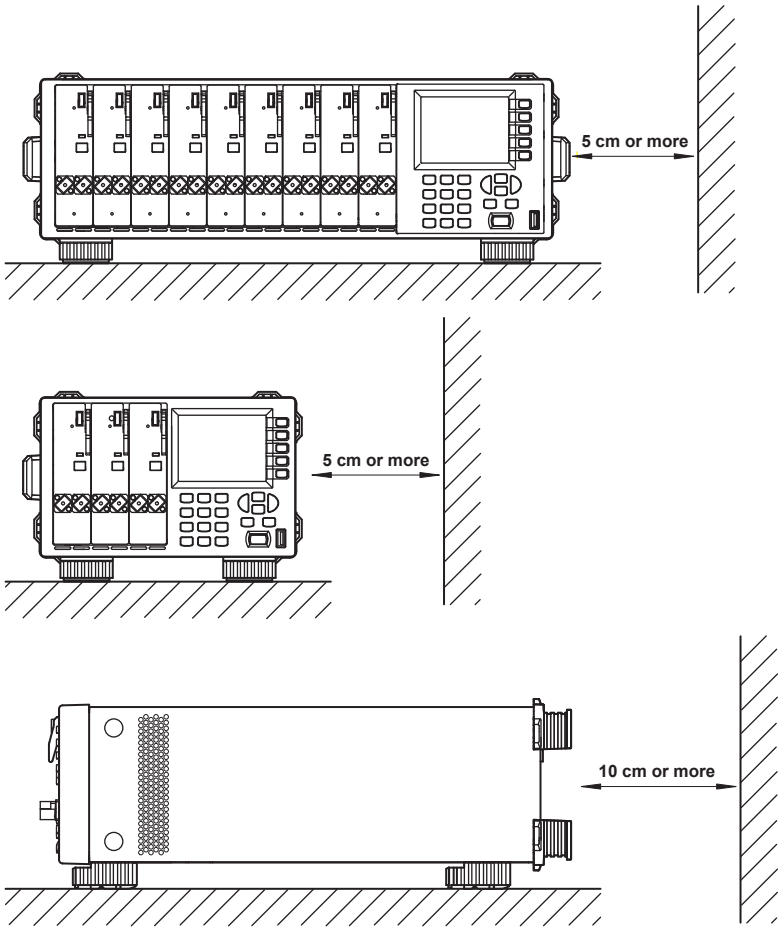
- Do not install the instrument outdoors or in locations subject to rain or water.
- Install the instrument so that you can immediately remove the power cord if an abnormal or dangerous condition occurs.

CAUTION

If you block the inlet holes on the right and bottom or the exhaust holes on the rear side of the instrument, the instrument will become hot and may break down.

Well-Ventilated Location

Inlet holes are located on the right and bottom of the instrument. There are also exhaust holes on the rear side. To prevent internal overheating, allow for enough space around the instrument (see the figure below), and do not block the inlet and exhaust holes.



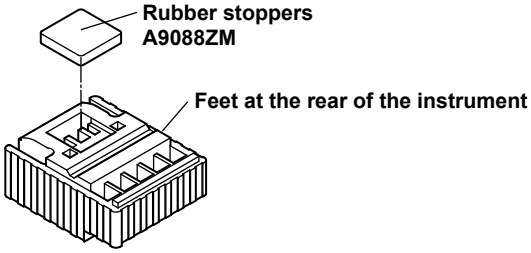
When connecting cables, allow for enough space, above and beyond the space shown in the figure above, to carry out the procedure.

Ambient Temperature and Humidity

Ambient temperature	5 to 40°C
Ambient humidity	20 to 80% RH (no condensation)

Flat, Even Surface

Install the instrument with the correct orientation on a stable, horizontal surface. If the instrument is installed in a horizontal position, rubber stoppers can be attached to the feet at the rear of the instrument to prevent the instrument from sliding. One set of rubber stoppers (two stoppers) are included with the instrument.



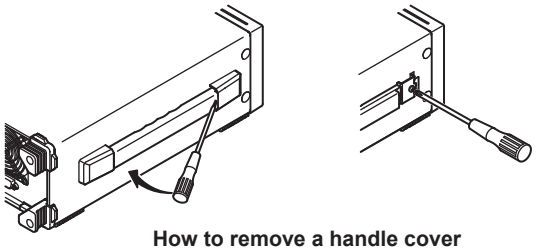
Rack Mounting

To rack-mount the instrument, use the separately sold rack mount kit.

Product Name	Model
AQ2211 rack mount kit (for mounting one AQ2211 to an EIA-standard rack)	735182-03
AQ2212 rack mount kit (for mounting one AQ2212 to an EIA-standard rack)	735182-09

An outline of the mounting procedure is given below. For detailed instructions, see the manual that is included with the rack mount kit.

1. Remove the handles from both sides of the instrument (from the left side of the instrument in the case of an AQ2211).
2. Remove the four feet from the bottom of the instrument.
3. Remove the four seals the rack mount attachment holes on each side of the instrument near the front.
4. Place seals over the feet and handle attachment holes.
5. Attach the rack mount kit to the instrument.
6. Mount the instrument on a rack.

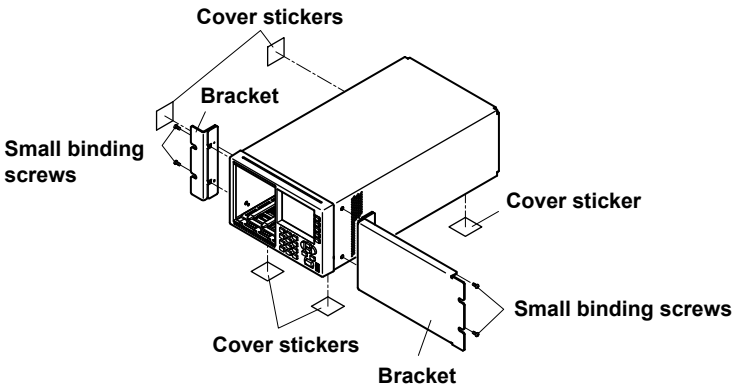


How to remove a handle cover

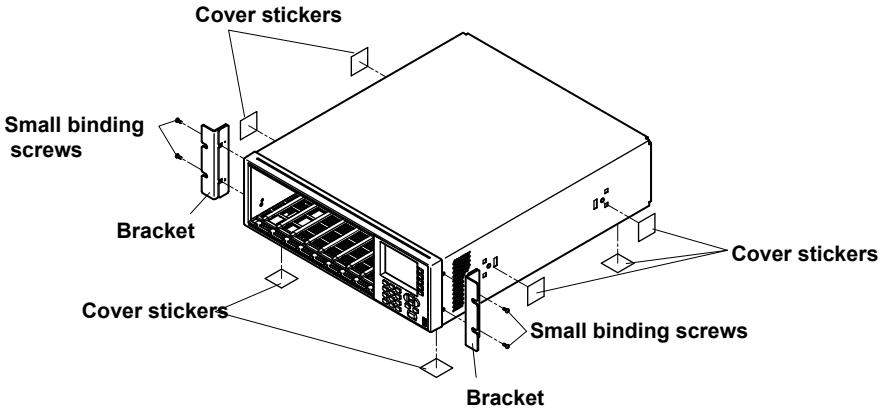
Note

- When rack-mounting the instrument, allow at least 10 cm of space around the inlet and exhaust holes to prevent internal heating.
- Make sure to provide adequate support from the bottom of the instrument. The support should not block the inlet and exhaust holes.
- Store the removed parts in a safe place.
- When rack-mounting the instrument, remove the feet from the rear of the instrument if they are coming into contact with the rack and are thus preventing you from rack-mounting the instrument. After you have rack-mounted the instrument, re-attach the feet to the rear of the instrument. In this case, be sure to attach the brackets to the instrument before you remove the feet from the rear of the instrument. If you don't, the instrument's cover may come loose and fall when you rack-mount the instrument.

• **Rack-Mounting to the AQ2211 Frame Controller**



• **Rack-Mounting to the AQ2212 Frame Controller**



Do Not Install the Instrument in the Following Kinds of Places

- In direct sunlight, or near sources of heat
- Near sources of strong magnetic fields
- In an environment where static electricity can easily be generated
- Near high-voltage equipment or power lines
- In an environment with excessive amounts of soot, steam, dust, or corrosive gases
- In an environment that is subject to large levels of mechanical vibration
- On an unstable surface

Storing the Instrument

- We recommend that the instrument be stored in an environment where the temperature is between 5 and 40°C and the relative humidity is between 20 and 80% RH.
- When storing the instrument, avoid the following kinds of places.
  - In direct sunlight
  - Where the temperature is 60°C or higher
  - Where the relative humidity is 80% or higher
  - Near a high-temperature heat source
  - Where the level of mechanical vibration is high
  - Where there are corrosive or explosive gasses
  - Where an excessive amount of soot, dust, salt, or iron is present
  - Where water, oil, or chemicals may splash
  - Outdoors or in locations subject to rain or water

2.3 Attaching and Removing Blank Panels

WARNING

To prevent electric shock, and to ensure that the instrument performs within its specifications, be sure to cover any unused slots with the blank panels sold separately.
If you use the instrument without covering empty slots with blank panels, the instrument may malfunction due to dust getting inside of it or its internal temperature rising.

Remove the blank panel when you install a module into the frame controller.

Removing a Blank Panel

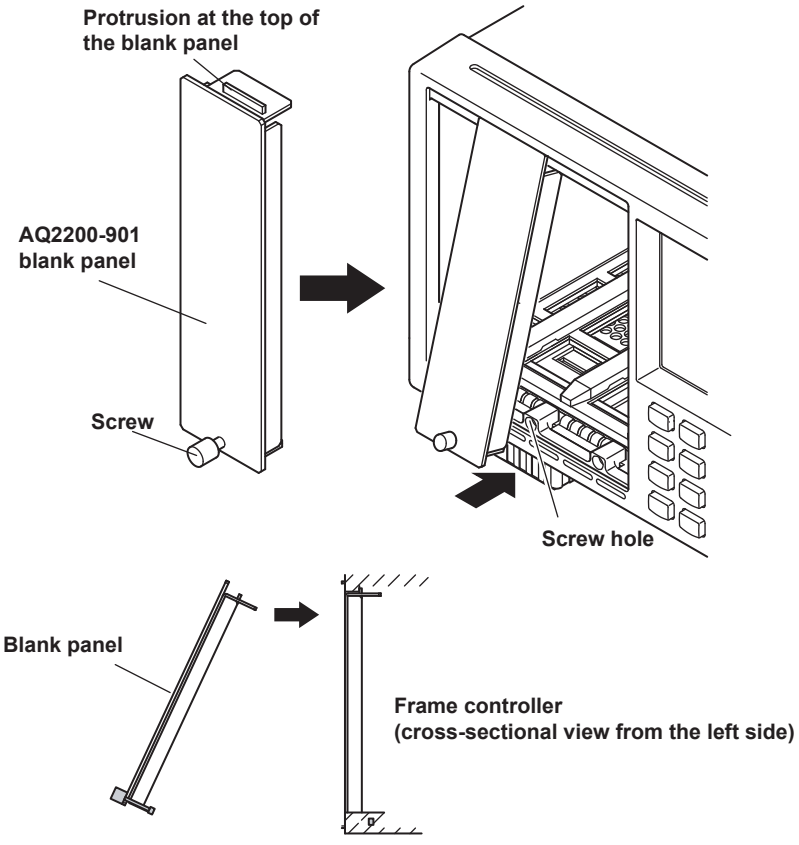
1. Loosen the screw at the bottom of the blank panel.
2. Grasp the screw at the bottom of the blank panel, and pull the panel toward you.
3. Slide the blank panel down until you remove it from the frame controller.

Note

The blank panel is constructed so that the screw does not fall out.

Attaching a Blank Panel

1. Align the protrusion at the top of the blank panel such that it catches on the top part of the frame controller slot.
2. Fasten the blank-panel screw into the screw hole on the bottom part of the frame controller slot.



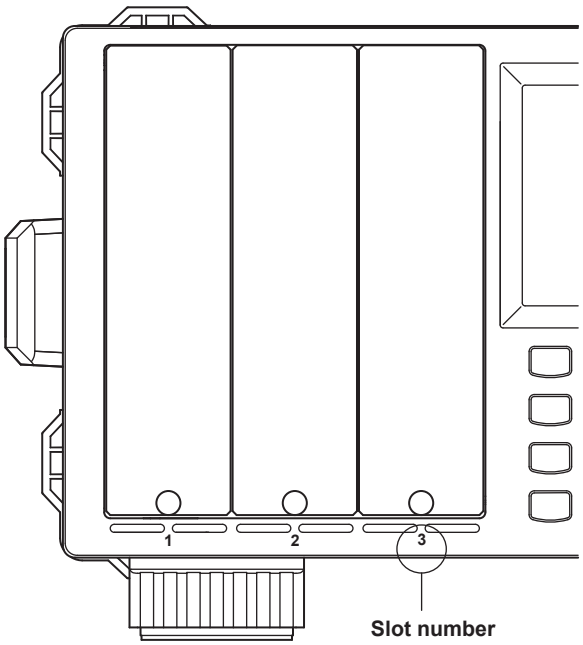
2.4 Installing and Uninstalling Modules

WARNING

- Do not apply a voltage that exceeds the maximum input voltage, withstand voltage, or allowable surge voltage.
- Be sure to fasten the screws that are at the bottom of the front panel of 2-slot and 3-slot modules. Otherwise, the mechanical protection function will not be activated.
- Do not leave the modules connected to the instrument in environments in which a voltage that exceeds the allowable surge voltage may occur.

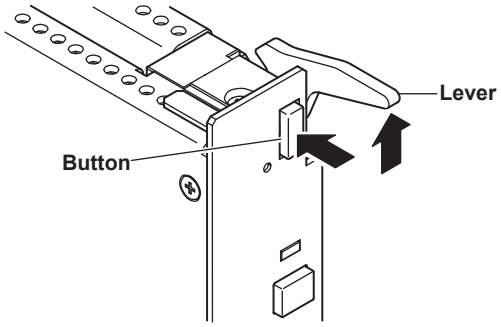
Module Installation Slots

You can install a maximum of three modules into the AQ2211 Frame Controller and a maximum of nine modules into the AQ2212 Frame Controller. The slots are assigned numbers 1, 2, 3, etc., starting from the left of the instrument, when the frame controller is viewed from the front.



Installing a Module

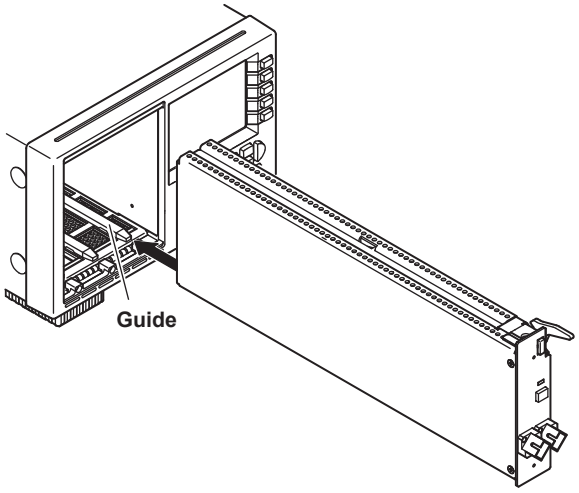
1. While pressing the button on the module panel, pull up on the lever.



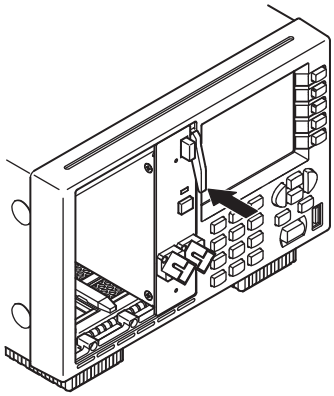
Note

When inserting a module, always check its vertical orientation.

2. Align the groove on the bottom of the module with the guide on the slot that you want to install the module into, and slowly insert the module into the frame controller.



3. After you have fully inserted the module, slowly but firmly push the lever until the button clicks.



Note

When you install a two-slot or three-slot module, tighten the screws to fix it in place.

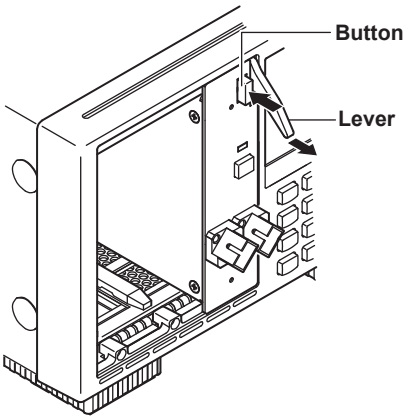
Uninstalling a Module

1. If you are uninstalling a two-slot or three-slot module, loosen the fixing screws.

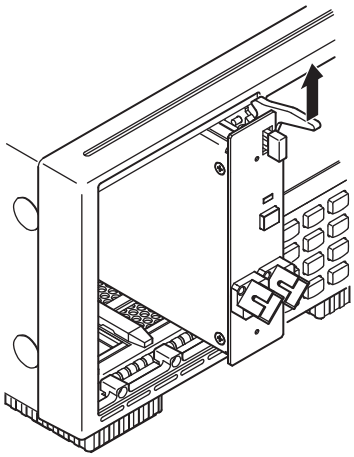
Note

The modules are constructed so that the fixing screws do not fall out.

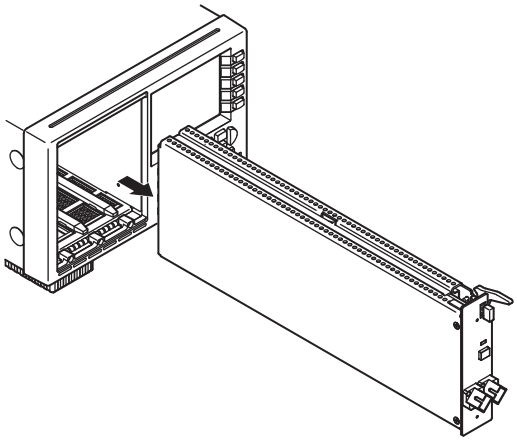
2. While pressing the button, lightly pull the lever up until it unlocks.



3. Slowly pull the lever up until the module projects approximately 1 cm out from the frame.



4 Slowly pull the module out from the slot.

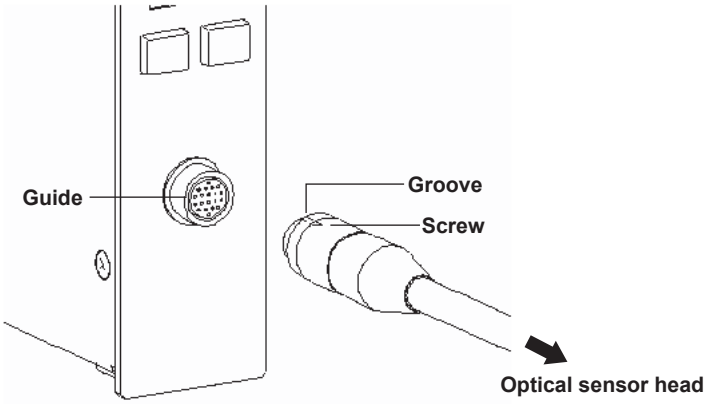


2.5 Connecting Cables

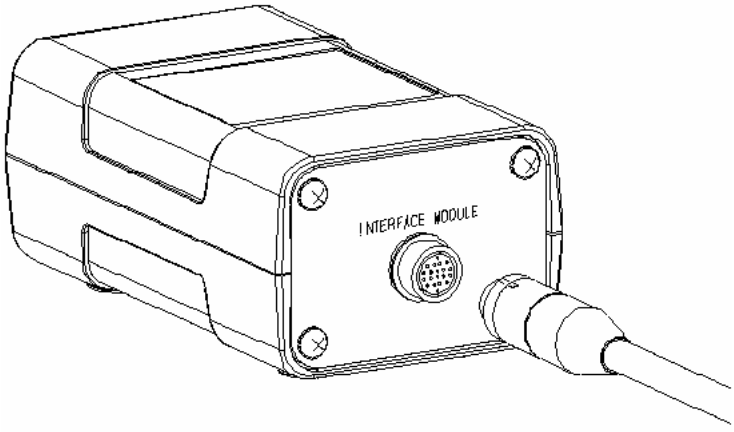
How to Connect the Optical Sensor Head and Interface Module

Connecting a Cable

1. Insert the cable connector into the connector on the front of the interface module (make sure that the guide pin of the connector on the module fits into the groove of the cable connector), and then tighten the screw to secure them.



2. Similarly, connect the cable to the connector on the rear panel of the optical sensor head.



CAUTION

If the interface module is currently installed in the frame controller, turn the frame controller off or uninstall the interface module from the frame controller, and then carry out the above procedure.

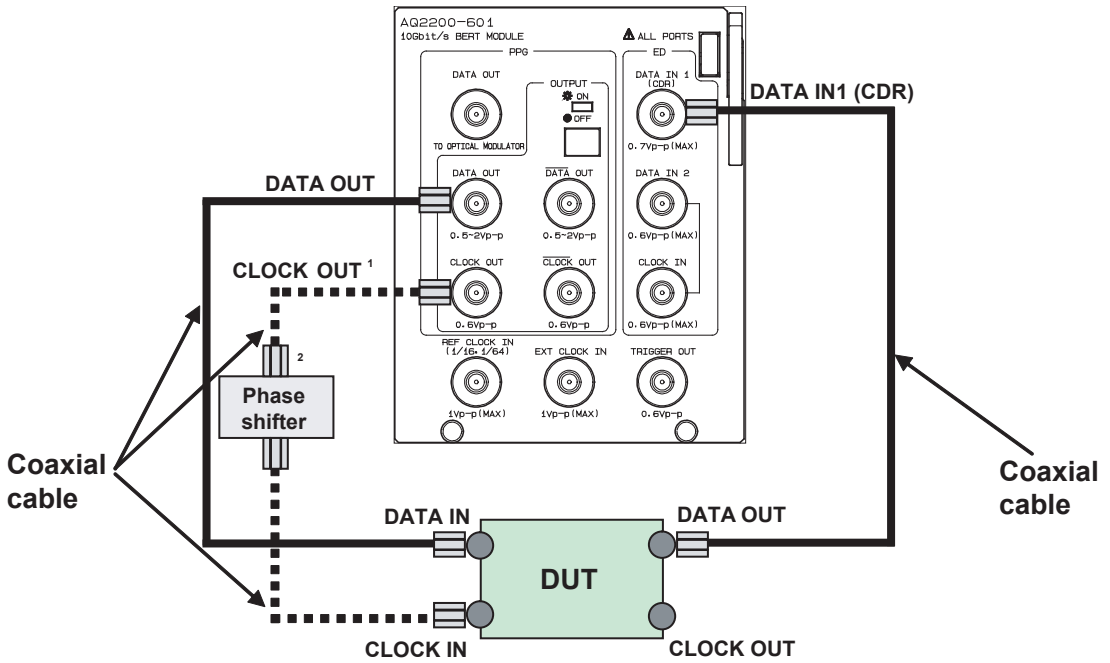
How to Connect Cables for BER Measurement

CAUTION

- Be sure to attach terminators to any unused output terminals.
  Terminators are attached to the module terminals by factory default.
- When making connections to I/O terminals, use a grounding strap or other method to prevent electrostatic discharge.
  If the cable that you are connecting is charged with static electricity, the instrument may malfunction, so always connect cables after they have been discharged.

Using the CDR Function through the Electrical Interface

Make the following connections to enable the DUT to use the CDR function of the BERT module through the electrical interface.



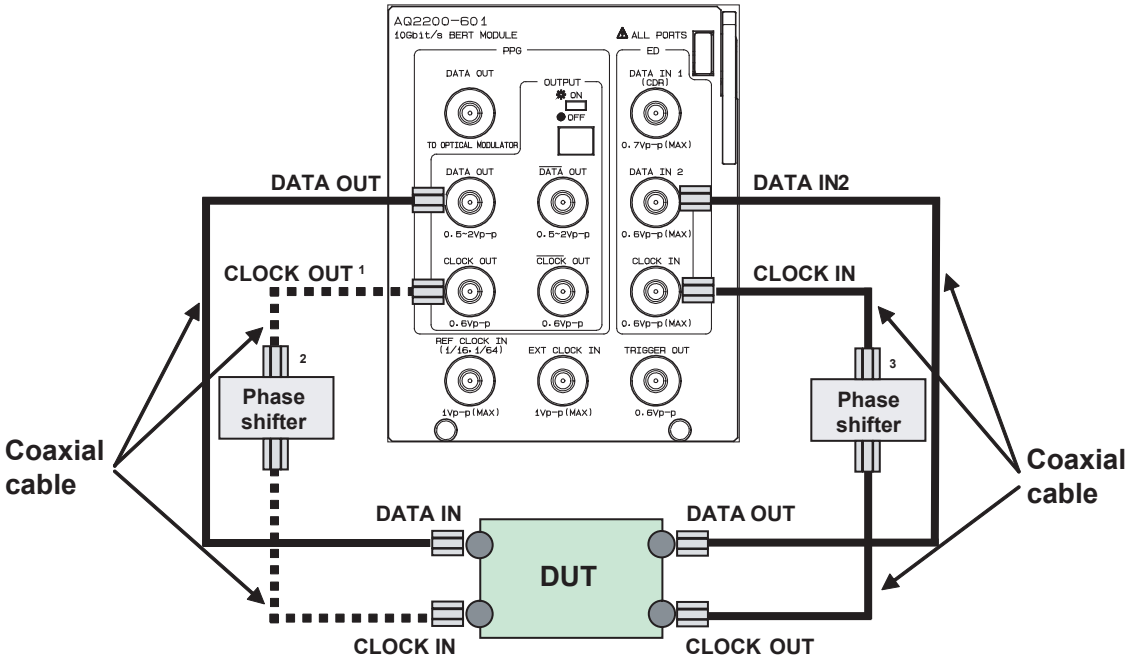
1 If the DUT needs the clock, connect the CLOCK OUT terminal to the DUT.
2 Use a phase shifter to adjust the phase to match the input of the DUT.

Note

The 10 Gbit/s data I/O terminals (DATA IN and DATA OUT) use 3.5 mm connectors that have excellent frequency characteristics. For the coaxial cables that you connect to these terminals, use low-loss, short cables that also have 3.5 mm connectors.

Not Using the CDR Function through the Electrical Interface

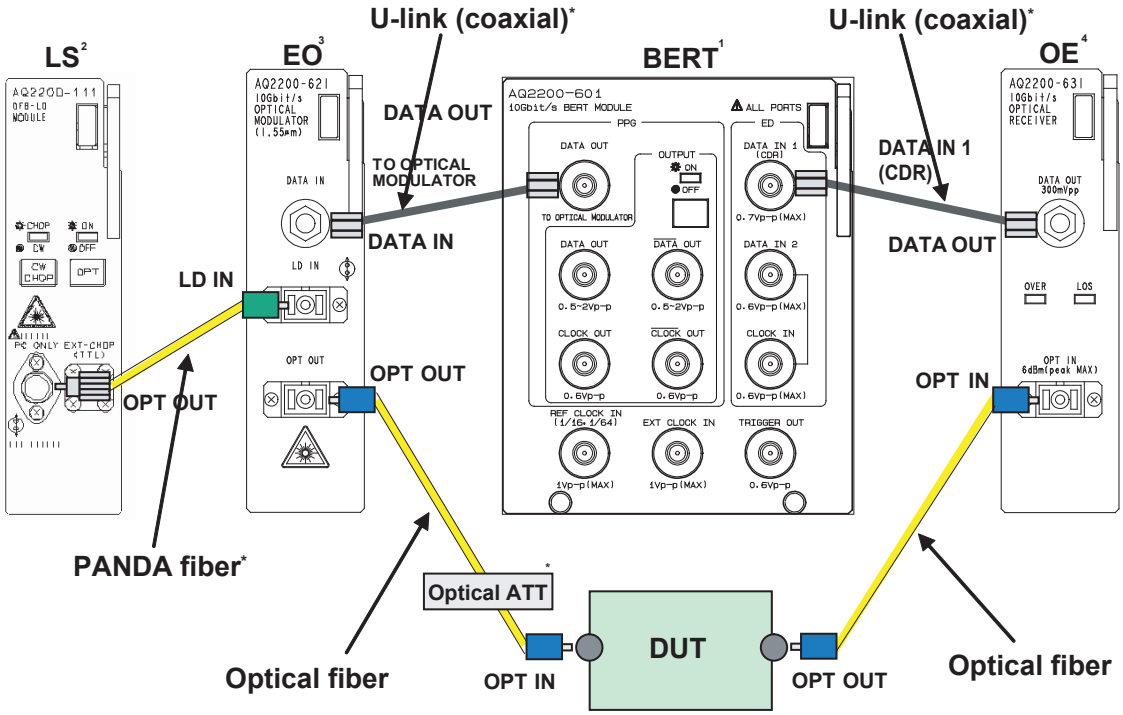
Make the following connections if the DUT will not use the CDR function of the BERT module through the electrical interface.



1 If the DUT needs the clock, connect the CLOCK OUT terminal to the DUT.
2 Use a phase shifter to adjust the phase to match the input of the DUT.
3 Because the CLOCK IN terminal of the ED does not have a phase adjustment function, use an external phase shifter to adjust the phase to match the input of the ED.

Using the Optical Interface

Make the following connections when the DUT has the optical interface and you are using a combination of a BERT module (BERT)[1], an AQ2200 series light source module (LS)[2], an optical modulator module (EO)[3], and an optical receiver module (OE)[4].



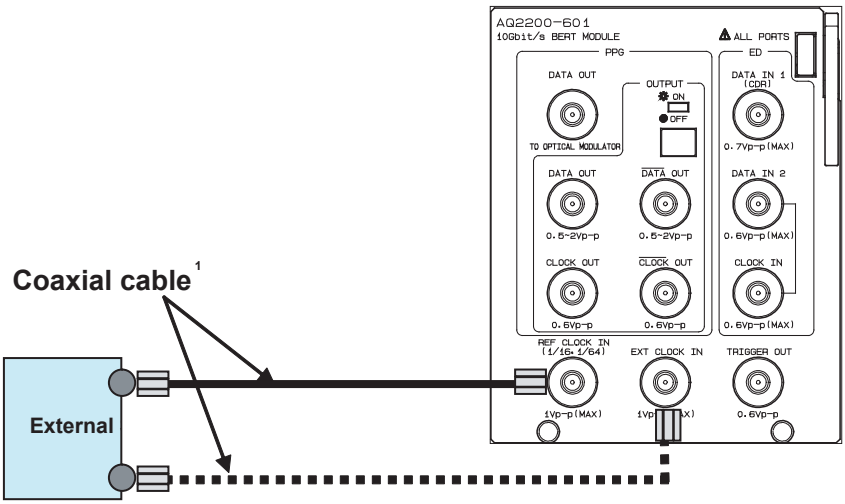
1 AQ2200-601 10 Gbit/s BERT module
2 AQ2200-111 DFB-LD module (-PMF suffix code)
3 AQ2200-621 10 Gbit/s optical modulator (1550 nm)
AQ2200-622 10 Gbit/s optical modulator (1310 nm)
4 AQ2200-631 10 Gbit/s optical receiver
* See Note below.

Note

- Use EO or OE modules with the /U option (sold separately) for U-links.
- Use EO modules with the /P option (sold separately) for PANDA fibers.
- To protect the DUT, insert optical attenuators as necessary.

Using an External SG

Make the following connections to use an external SG (signal generator).
See “Using the CDR Function through the Electrical Interface,” “Not Using the CDR Function through the Electrical Interface,” and “Using the Optical Interface,” for instructions on how to make connections to the DUT.



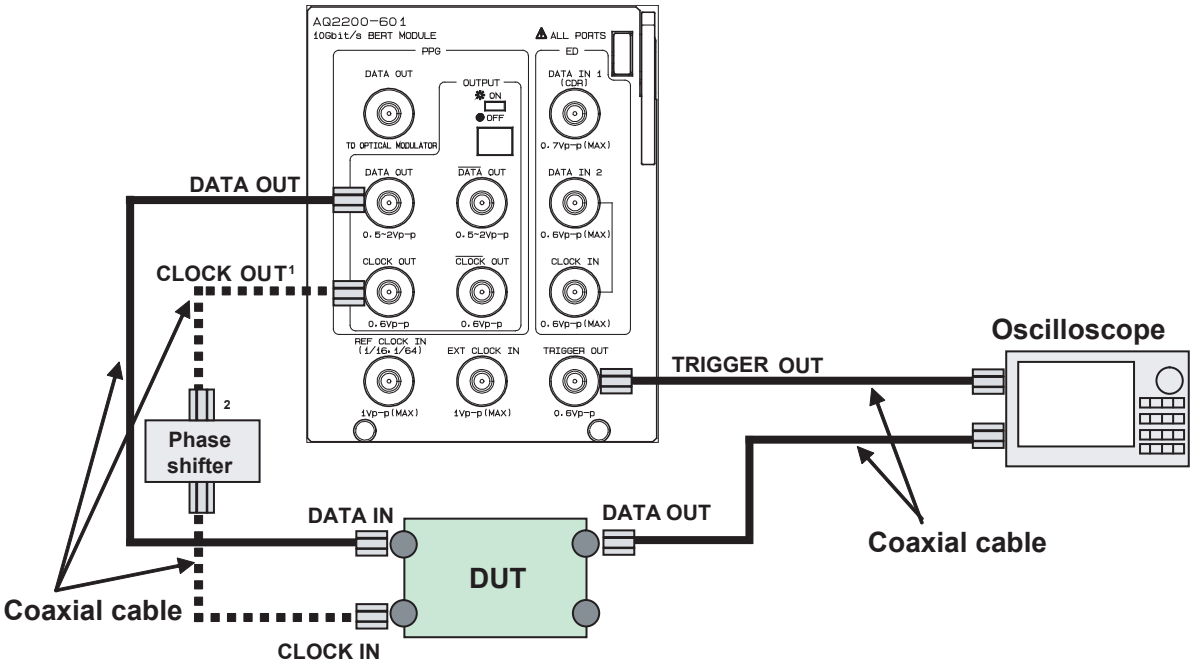
* If you want to use an external signal generator that has a frequency that is 1/16 or 1/64 the bitrate, connect it to the BERT module’s REF CLOCK IN terminal.
If you want to use an external signal generator of the 10 GHz band, connect it to the BERT module’s EXT CLOCK IN terminal.

Note

If you want to use a reference clock, make sure to apply a rectangular signal from the external signal generator.

Using the Trigger Terminal

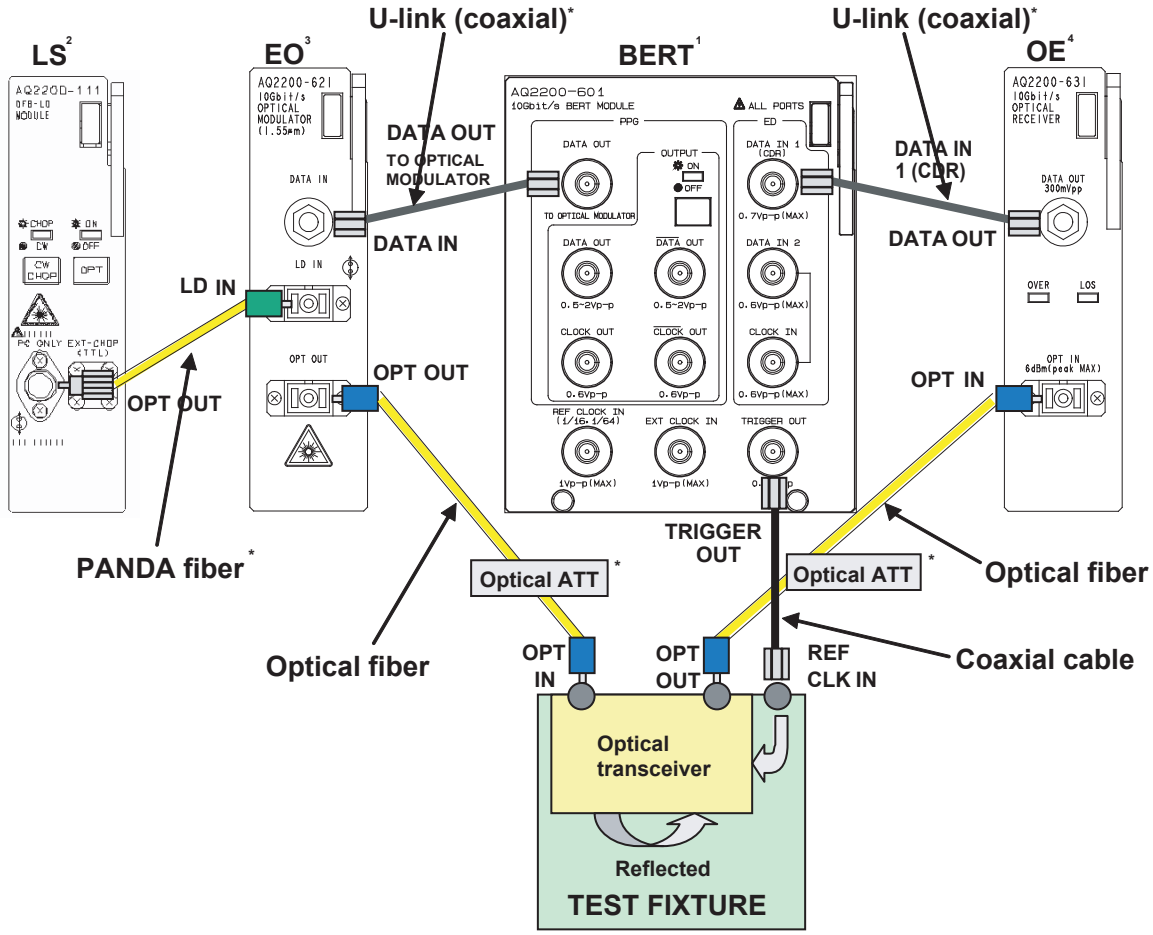
- **Using the Trigger Terminal to Generate Trigger Signals for Waveform Monitoring**
  Make the following connections if you want to use the trigger terminal to generate trigger signals for an oscilloscope.



1 If the DUT needs the clock, connect the CLOCK OUT terminal to the DUT.
2 Use a phase shifter to adjust the phase to match the input of the DUT.

Using the Trigger Terminal to Generate the Reference Clock of an Optical Transceiver

Make the following connections if you want to use the trigger terminal to generate the reference clock of an optical transceiver.



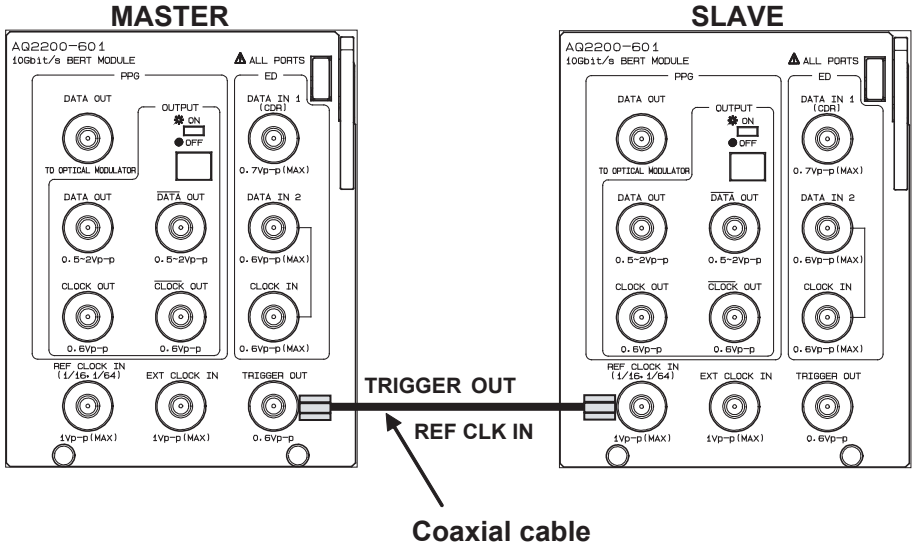
1 AQ2200-601 10 Gbit/s BERT module
2 AQ2200-111 DFB-LD module (-PMF suffix code)
3 AQ2200-621 10 Gbit/s optical modulator (1550 nm)
AQ2200-622 10 Gbit/s optical modulator (1310 nm)
4 AQ2200-631 10 Gbit/s optical receiver
* See Note below.

Note

- Use EO or OE modules with the /U option (sold separately) for U-links.
- Use EO modules with the /P option (sold separately) for PANDA fibers.
- To protect the DUT, insert optical attenuators as necessary.

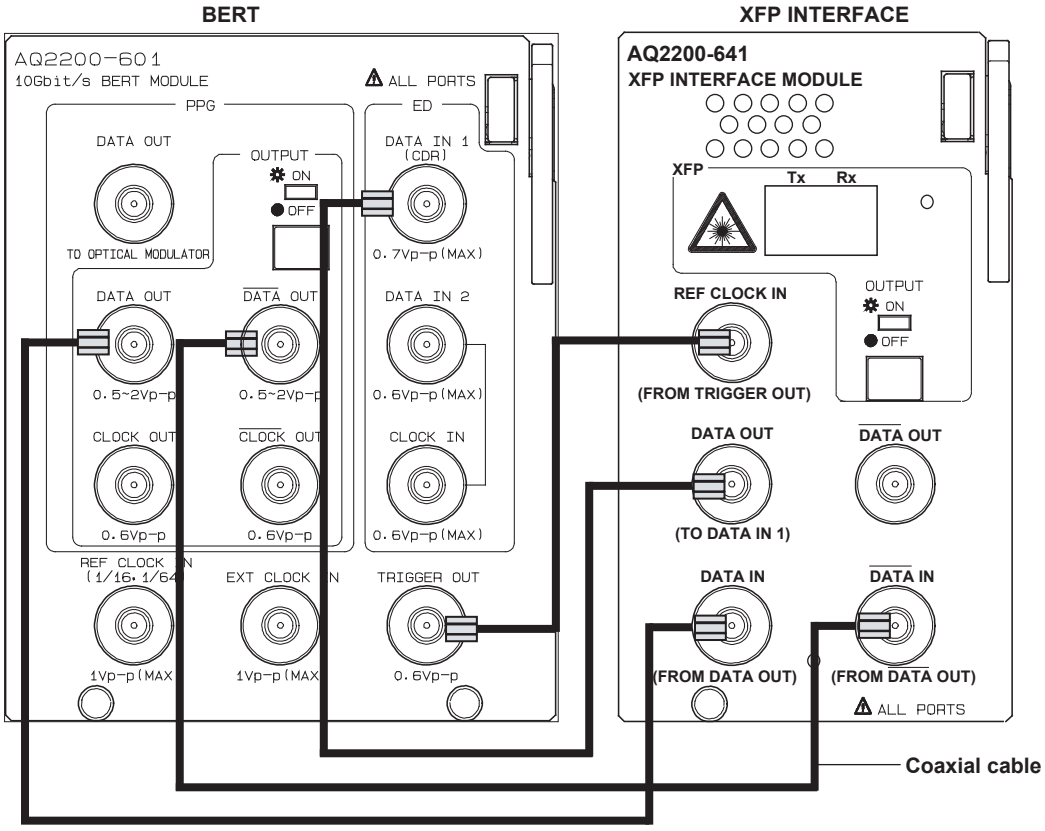
Using the Trigger Terminal to Generate a Reference Clock for Synchronizing Multiple Instruments

Make the following connections if you want to use the trigger terminal to synchronize multiple instruments.



Using the XFP Interface

Make the following connections between the BERT and the XFP interface if you want to use the XFP optical transceiver as the DUT.



Note

Before you install or uninstall the XFP transceiver, turn off the output from the connected AQ2200-601.

Connecting Cables

When connecting this instrument to the DUT, to another module, or to a measuring instrument, take appropriate measures to protect the instrument from static electricity.

CAUTION

Before attaching and detaching cables or terminators to this instrument's connectors, ground the instrument or connect the operator to a metallic part of the main frame to protect against static electricity.
Static electricity may cause the instrument to malfunction.

Connectors

- When this instrument is not being used, attach terminators to the coaxial connectors and protective caps to the optical connectors.
- Before connecting a cable to a connector, turn off the signal generator and light source outputs.
- Use a torque wrench to tighten coaxial connectors. The proper tightening torque is 0.9 N-m. Excessive torque may cause damage to the connector.

CAUTION

If you are connecting a U-link or regular cable to a connector, match the cable's connector type to the instrument's connector, and connect the cable properly. Using unspecified connectors to connect cables may cause damage to the connectors.

2.6 Connecting and Disconnecting Connector Adapters

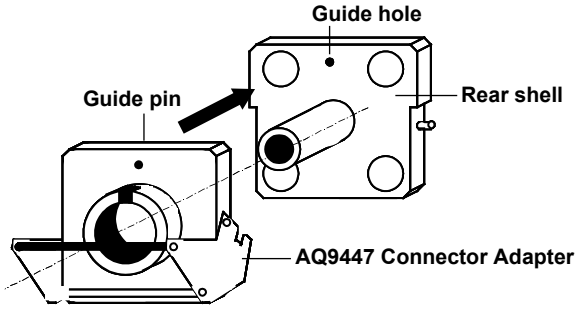
By changing the connector adapter, you can connect the light source modules (with the exception of the DFB-LD, TLS and Grid TLS) and sensor modules to a variety of optical connectors.

How to Connect and Disconnect the AQ9447 Connector Adapter

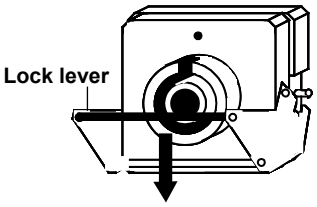
The AQ9447 Connector Adapter can be used with the AQ2200-211 sensor module.

Connecting the Adapter

1. Fit the guide pins of the connector adapter into the guide holes on the rear shell.

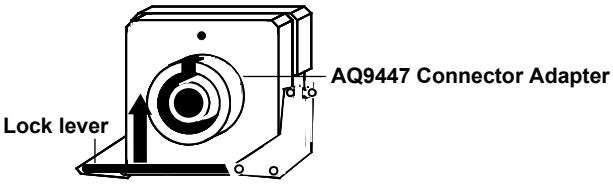


2. Lock the connector adapter by pushing the lock lever down until you hear a click.

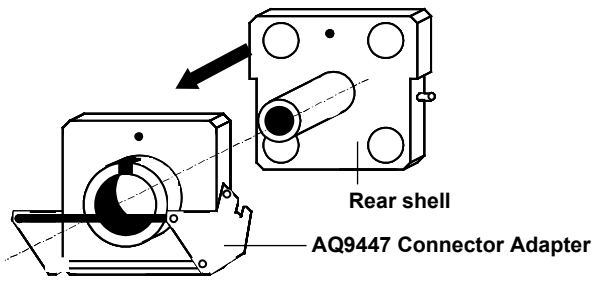


Disconnecting the Adapter

1. Lift the lock lever on the AQ9447 Connector Adapter to unlock it.



2. Pull the lock lever toward you and remove the connector adapter from the rear shell.

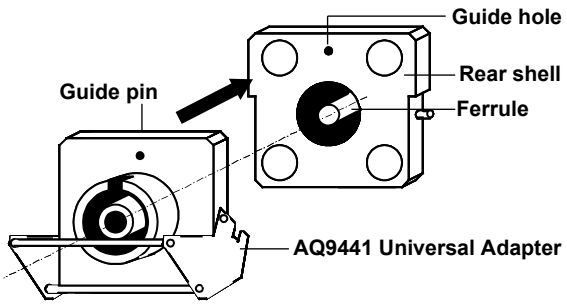


How to Connect and Disconnect the AQ9441 Universal Adapter

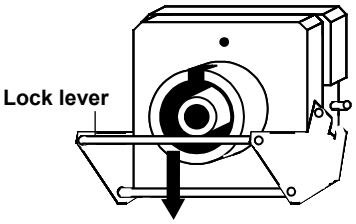
The AQ9441 Universal Adapter can be used with the AQ2200-141 FP-LD and AQ2200-142 DUAL FP-LD modules.

Connecting the Adapter

1. Fit the guide pins of the universal adapter into the guide holes on the rear shell. Take care not to let the universal adapter come in contact with the end of the ferrule that extends from the rear shell.

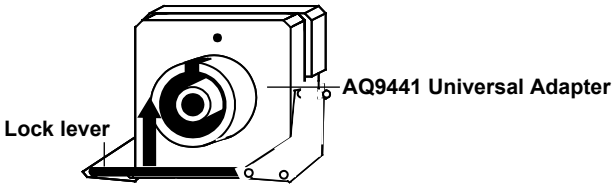


2. Lock the universal adapter by pushing the lock lever down until you hear a click.

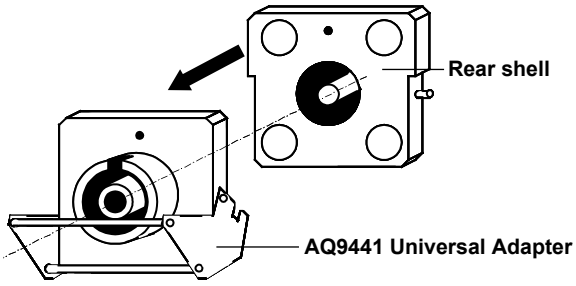


Disconnecting the Adapter

1. Lift the lock lever on the AQ9441 Universal Adapter to unlock it.



2. Pull the lock lever toward you, and slowly remove the universal adapter from the rear shell.



How to Connect and Disconnect the AQ9335C Connector Adapter

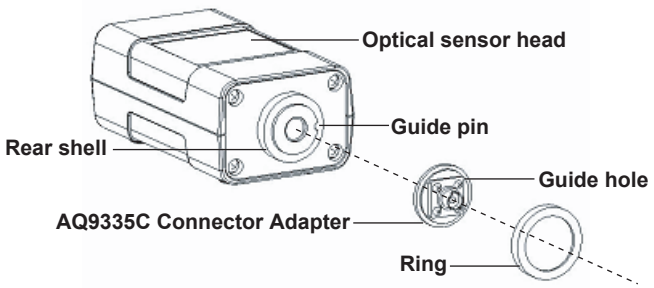
The AQ9335C Connector Adapter can be used with the AQ2220-231 Optical Sensor Head, AQ2200-241 Optical Sensor Head, AQ2200-215 Sensor Module, and AQ2200-221 Sensor Module.

Connecting the Adapter

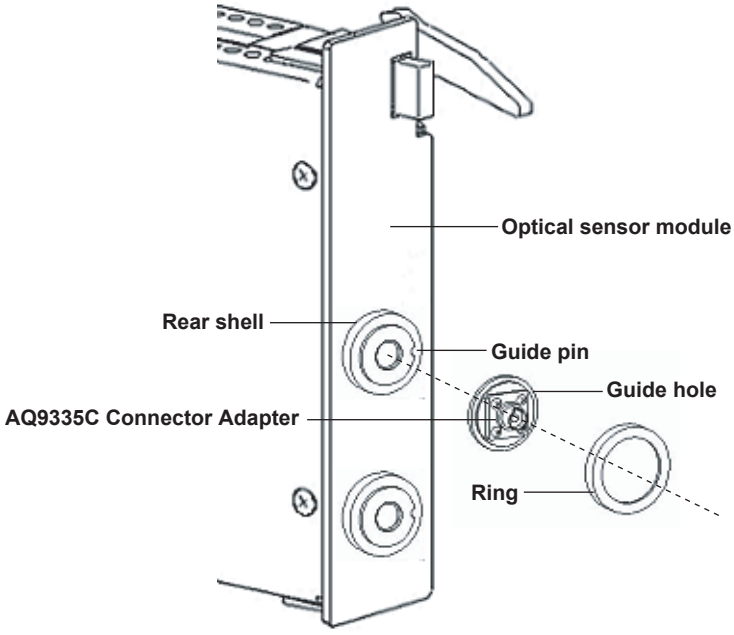
1. Fit the guide holes of the connector adapter onto the guide pins on the rear shell.
2. Screw in the connector adapter's ring to secure the adapter.

Disconnecting the Adapter

1. Turn the ring to remove the connector adapter.



How to Connect the Connecter Adapter to an Optical Sensor Head



How to Connect the Connecter Adapter to a Sensor Module

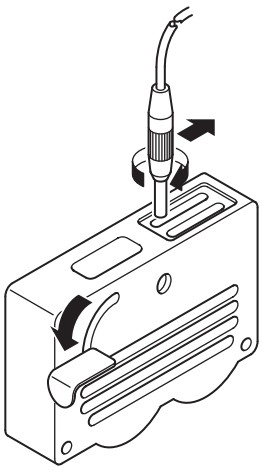
2.7 Connecting Optical Fiber Cables

CAUTION

Only connect angled-physical-contact type optical fibers to the ANGLED PC ONLY optical connector. Other types of connectors can damage the connector's ferrule end.

Clean the connector end face of the optical fiber cable under measurement before connecting it to the instrument. If dust is adhered to the connector end face, it may damage the instrument's optical connector. If this happens, the instrument will not be able to make correct measurements.

1. Firmly press the connector end face of the optical fiber cable against the cleaning surface of the cleaner.
2. While pressing the end face against the cleaner, turn the cable.
3. While pressing the end face against the cleaner, move the cable.
4. Change the cleaning surface of the cleaner, and repeat steps 1 to 3.



Note

- If you do not firmly press the connector end face of the optical fiber cable against the cleaner, the end face may not be cleaned completely.
- You can purchase an optical fiber connector cleaner from NTT-AT Corporation.

2.8 Connecting to the Power Supply

Before Connecting the Power Supply

Make sure to follow the warnings below when connecting the power supply. Failure to do so may cause electric shock or damage to the instrument.

WARNING

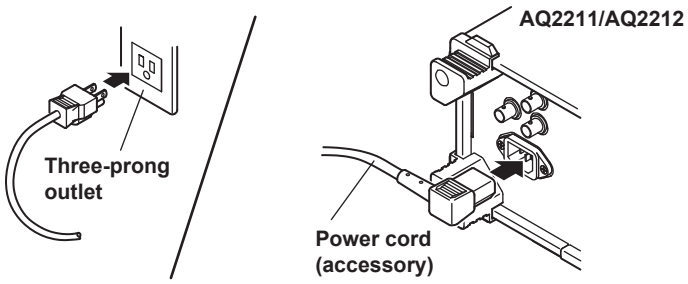
- Make sure that the power supply voltage matches the instrument's rated supply voltage and that it does not exceed the maximum voltage range specified for the power cord.
- Confirm that the frame controller's power switch is off before connecting the power cord.
- To prevent fire and electric shock, be sure to use the power cord supplied by YOKOGAWA for the frame controller.
- To prevent electric shock, make sure to ground the instrument. Insert the frame controller's power cord into a grounded three-prong outlet.
- Do not use an ungrounded extension cord. If you do, the instrument will not be grounded.
- If an AC outlet that conforms to the supplied power cord is unavailable and you can not ground the instrument, do not use the frame controller.

Connecting the Power Cord

1. Check that the power switch is off.
2. Connect the power cord plug to the power inlet on the rear panel.
3. Connect the other end of the cord to an outlet that meets the following conditions.
   Use a grounded three-prong outlet.

Rated supply voltage*	100 to 240 VAC (auto switching)
Rated supply frequency	50/60 Hz
Maximum power consumption	AQ2211: 170 VA; AQ2212: 580 VA (including installed modules)

* This instrument can use a 100 V or a 200 V power supply. The maximum rated voltage differs according to the type of power cord. Check that the voltage supplied to the instrument is less than or equal to the maximum rated voltage of the power cord provided with the instrument before using it (see page iv for the maximum rated voltage).



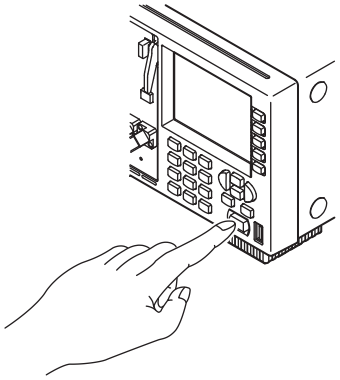
Turning the Instrument On

Before Turning On the Power, Check That:

- The instrument is installed properly (see section 2.2, “Installing the Instrument”).
- The power cord is connected properly (see the previous page).

Turning the Instrument On

1. Press the front panel power switch.



Turning the Instrument Off

CAUTION

- Turning the instrument off or unplugging the power cord while the instrument is saving data may corrupt the media on which data is being saved. The data being saved is also not guaranteed. Always turn the instrument off after data has been saved.
- Turn the BERT module’s signal output off when you turn the instrument off. Otherwise, the BERT module may be damaged.

Turning the Instrument Off

1. Press the front panel power switch.

Operations Performed When the Power Is Turned On

When the power switch is turned on, a self-test starts automatically. If the results of the test are satisfactory, the SUMMARY screen or the DETAIL screen appears.

Note

- If the operations described above are not carried out after the power switch is turned on, or if the SUMMARY or DETAIL screen does not appear, turn the power switch off, and check that:
  - The power cord is securely connected.
  - The correct voltage is coming to the power outlet (see the previous page).

  If the instrument still does not work properly, contact your nearest YOKOGAWA dealer for repairs.
- Depending on the type and number of modules that are installed in the frame controller, it may take some time for the startup screen to appear.

For Taking Accurate Measurements

Allow the instrument to warm up for at least one hour after turning on the power switch.

3.1 Frame Controller

Interlock (REMOTE INTERLOCK)

CAUTION

Only apply signals that meet the specifications. Doing otherwise may damage the instrument.

Interlock Connector

The frame controller is equipped with an interlock terminal as a laser output safety device.
If this terminal is open (nothing is connected to it), the frame controller is in the OPT LOCK state, and the laser light source cannot generate a laser beam.

Item	Specifications
Connector type	BNC, contact input

Trigger In (TRIGGER IN)

CAUTION

Only apply signals that meet the specifications. Signals that do not meet the specifications, such as those with excessive voltage, may damage the instrument

External Trigger Input Terminal

This terminal receives external trigger signals for starting measurements on sensor modules.

Item	Specifications
Connector type	BNC
Input level	TTL level
Input pulse width	50 μs or more
Input impedance	Approx. 5 kΩ

Trigger Out (TRIGGER OUT)

CAUTION

Do not apply an external voltage to the TRIGGER OUT terminal. Doing so may damage the instrument.

External Trigger Output Terminal

This terminal transmits an external trigger signal in sync with the measurement timing of the sensor modules.

Item	Specifications
Connector type	BNC
Output level	TTL level
Output pulse width	Approx. 50 μs
Output impedance	Approx. 100 Ω

3.2 Optical Sensor Modules

Analog Out (ANALOG OUT)

Analog Signal Output Terminal

This terminal transmits a voltage level that corresponds to the level of the optical signal that is applied to the sensor.

Use cables that are 3 m or shorter in length.

ANALOG OUT

Item	Specifications
Connector type	Mini plug
Output level	
AUTO mode	Approx. 0 to 2 V, proportional to the measurement power (W) for each power range
LINEAR mode	Approx. 0 to 2 V, proportional to the range set for measurement power (W)
LOG mode	Approx. 0 to 2 V, proportional to the range set for measurement power (dBm)
Output impedance	Approx. 1 kΩ

3.3 BERT Module

CAUTION

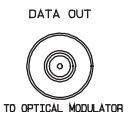
This precision measuring instrument handles high-speed signals at a rate of 10 Gbit/s. If the following precautions are not observed strictly, the instrument will not be able to deliver its maximum performance and may malfunction.

- Before removing modules from the frame controller, turn the output off.
- Before turning the frame controller off, turn the output off.
- Before connecting cables to or disconnecting cables from the I/O terminals, turn the output off.
- Before connecting cables to the I/O terminals, tighten the connectors at a specified torque using a torque wrench.
- Do not leave the DATAOUT, $\overline{\text{DATAOUT}}$, CLOCKOUT, and $\overline{\text{CLOCKOUT}}$ output terminals open. Always terminate them with 50 Ω loads, such as the included terminators. Likewise, always terminate the cables that are connected to these output terminals with 50 Ω loads.
- Do not apply a signal that is greater than the specified maximum input voltage to the input terminals.
- When connecting cables to the I/O terminals, use a grounding strap to prevent electrostatic discharge.
  If the cables are charged with static electricity, the instrument may malfunction. Always connect cables after they have been discharged.
- Before connecting the unit to the DUT,* turn the output off.
- Before connecting the frame controller to the power supply, connect the power cord to a properly grounded three-prong outlet.
- Always use the specified connector to connect this module's I/O terminals. Using unspecified connectors to connect the I/O terminals may cause damage to the terminals and the connectors.
- When attaching connectors to the I/O terminals, always connect them straight, not at an angle. Attaching connectors to the I/O terminals at an angle may cause damage to the I/O terminals or the connectors' core wires.
- Do not apply external voltage to the output terminals.

* DUT stands for device under test.

Data Output Terminal to Optical Modulator (DATA OUT TO OPTICAL MODULATOR)

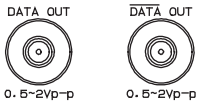
This terminal transmits non-inverted data. It is used when this module is combined with an optical modulator module.



Item	Specifications
Connector type	3.5 mm, female
Output level	0.50 ± 0.1 Vp-p
Offset voltage	0 V (fixed)
Cross point	50% (nominal value)
Output terminator conditions	50 Ω AC terminator

Data Output Terminals (DATA OUT and $\overline{\text{DATA}}$ OUT)

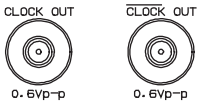
These terminals transmit 10 Gbit/s non-inverted and inverted data respectively.



Item	Specifications
Connector type	3.5 mm, female
Output level	0.5 to 2.0 Vp-p (in 10 mV steps)
Offset voltage	–2 to +3 V (in 10 mV steps)
Cross point	30 to 70% (in 1% steps)
Output terminator conditions	50 Ω AC or DC terminator
Bitrate	9.95 to 11.32 Gbit/s
Data format	NRZ
Tr/Tf (20 to 80%)	25 ps or less

Clock Signal Output Terminals (CLOCK OUT and $\overline{\text{CLOCK}}$ OUT)

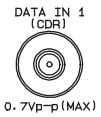
These terminals transmit 10 GHz non-inverted and inverted clock signals respectively.



Item	Specifications
Connector type	SMA, female
Output level	0.6 Vp-p (typical) AC-coupling
Offset voltage	–2 to +3 V (in 10 mV steps)
Output terminator conditions	50 Ω AC or DC terminator
Tr/Tf (20 to 80%)	25 ps or less
Duty	50% ± 10%

Data Input Terminal (DATA IN1 (CDR))

This receives ED data. It has a built-in CDR.



Item	Specifications
Connector type	3.5 mm, female
Input level	0.1 to 0.7 Vp-p
Minimum input sensitivity	100 mVp-p or less
Threshold voltage	±0.35 V (in 1 mV steps)
Input terminator conditions	50 Ω AC-coupling
Bitrate	9.95 to 11.32 Gbit/s
Allowable bitrate	±100 ppm of the PPG's operation bitrate
Data format	NRZ

Data Input Terminal (DATA IN2)

This terminal receives 10 Gbit/s data.

Item	Specifications
Connector type	3.5 mm, female
Input level	0.1 to 0.6 Vp-p
Minimum input sensitivity	100 mVp-p or less
Threshold voltage	±0.3 V (in 1 mV steps)
Input terminator conditions	50 Ω AC-coupling
Bitrate	9.95 to 10.71 Gbit/s

Clock Signal Input Terminal (CLOCK IN)

This terminal receives 10 Gbit/s clock signals.

Item	Specifications
Connector type	SMA, female
Input level	0.2 to 0.6 Vp-p
Input terminator conditions	50 Ω AC-coupling
Frequency	The same frequency as DATA IN 2 (synchronized to the data input)

External Clock Signal Input Terminal (EXT CLOCK IN)

If you want to operate the BERT module with an external clock signal at a rate of 10 GHz, without using the internal SG, apply a 10 GHz clock signal to this terminal.

Item	Specifications
Connector type	SMA, female
Input level	0.4 to 1.0 Vp-p
Input terminator conditions	50 Ω AC-coupling or DC-coupling
Frequency	The same frequency as the bitrate
Duty	50% (nominal value)

External Synchronization Signal Input Terminal (REF CLOCK IN)

If you want to synchronize the BERT module with an external clock signal, without using the internal SG, apply a reference signal that has a frequency that is 1/16 or 1/64 of the 10 Gbit/s rate to this terminal.

Item	Specifications
Connector type	SMA, female
Input level	0.4 to 1.0 Vp-p
Input terminator conditions	50 Ω AC-coupling
Frequency	1/16 or 1/64 of the bitrate
Duty	50%-rectangular signal (nominal)

Trigger Output Signal Terminal (TRIGGER OUT)

This terminal transmits the selected trigger signal (clock, pattern, or error).

Item	Specifications
Connector type	SMA, female
Output level	0.6 Vp-p ± 0.3 V
Output terminator conditions	50 Ω AC or DC terminator

3.4 Optical Modulator Module

CAUTION

- When connecting a cable to the data input terminal, use a grounding strap to prevent electrostatic discharge. If the cable is charged with static electricity, the instrument may malfunction. Always connect cables after they have been discharged.
- If you are connecting a U-link or regular cable to a connector, match the cable' s connector type to the instrument's connector, and connect the cable properly. Using unspecified connectors to connect cables may cause damage to the connectors.
- Do not apply voltages that exceed the maximum input level to the data input terminal.

Data Input Terminal (DATA IN)

Use a U-link (/U option) or coaxial cable to connect this terminal to the DATA OUT (TO OPTICAL MODULATOR) terminal on the PPG of a BERT module.

Item	Specifications
Connector type	3.5 mm jack or equivalent
Input level	0.5 ± 0.1 Vp-p (AC-coupling)
Maximum input level	1.2 Vp-p (AC-coupling)

3.5 Optical Receiver Module

CAUTION

- When connecting a cable to the data output terminal, use a grounding strap to prevent electrostatic discharge. If the cable that you are connecting is charged with static electricity, the instrument may malfunction, so always connect cables after they have been discharged.
- If you are connecting a U-link or regular cable to a connector, match the cable' s connector type to the instrument's connector, and connect the cable properly. Using unspecified connectors to connect cables may cause damage to the connectors.
- Do not apply an external voltage to the data output terminal. Doing so may damage the instrument.

Data Output Terminal

Use a U-link (/U option) or coaxial cable to connect this terminal to the DATA IN terminal on the ED of a BERT module.

Item	Specifications
Connector type	3.5 mm jack or equivalent
Saturated output level	0.3 Vp-p or greater (AC-coupling)

3.6 XFP Interface Module

CAUTION

- Before connecting cables to or disconnecting cables from the I/O terminals, turn the output off.
- Before connecting cables to the I/O terminals, tighten the connectors at a specified torque using a torque wrench.
- Do not leave the data and clock output terminals open. Always terminate them with 50 Ω loads, such as the included terminators.
  Likewise, always terminate the cables that are connected to these output terminals with 50 Ω loads.
- Do not apply a signal that is greater than the specified maximum input voltage to the input terminals.
- When connecting cables to the I/O terminals, use a grounding strap to prevent electrostatic discharge.
  If the cables are charged with static electricity, the instrument may malfunction. Always connect cables after they have been discharged.
- Always use the specified connector to connect this module's I/O terminals. Using unspecified connectors to connect the I/O terminals may cause damage to the terminals and the connectors.
- When attaching connectors to the I/O terminals, always connect them straight, not at an angle. Attaching connectors to the I/O terminals at an angle may cause damage to the I/O terminals or the connectors' core wires.
- Do not apply external voltage to the output terminals.

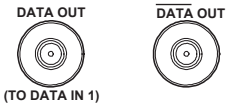
External Clock Input Terminal (REF CLOCK IN)

If you want to synchronize the XFP interface module with an external clock signal and use the module to operate a transceiver, apply a reference signal that has a frequency that is 1/64 of the 10 Gbit/s rate to this terminal.

Item	Specifications
Connector type	SMA, female
Input level	0.6 Vp-p ± 0.3 V
Frequency	1/64 of the bitrate

Data Output Terminals (DATA OUT and $\overline{\text{DATA}}$ OUT)

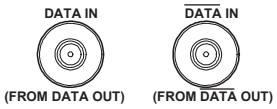
These terminals transmit 10 Gbit/s non-inverted and inverted data respectively.



Item	Specifications
Connector type	3.5 mm, female
Data format	NRZ

Data Input Terminals (DATA IN and $\overline{\text{DATA}}$ IN)

These terminals receive 10 Gbit/s non-inverted and inverted data respectively.



Item	Specifications
Connector type	3.5 mm, female
Data format	NRZ

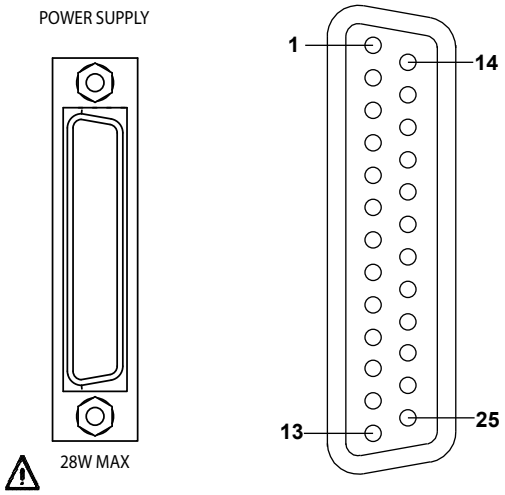
3.7 Transceiver I/F Module

CAUTION

- Always use the specified connector to connect this module's I/O terminals. Using unspecified connectors to connect the I/O terminals may cause damage to the terminals and the connectors.
- Before connecting cables to or disconnecting cables from the connectors, turn the output off.
- Do not apply a signal that is greater than the specified maximum input voltage to an input pin (a pin whose I/O attribute is I) on the SIGNAL connector.
- Make sure that the maximum power consumption for POWER SUPPLY connector signals PS1 to PS5 is below 28 W.
- Do not apply more than 1 A to a POWER SUPPLY connector pin.

POWER SUPPLY Port (POWER SUPPLY)

Provides power to the transceiver.



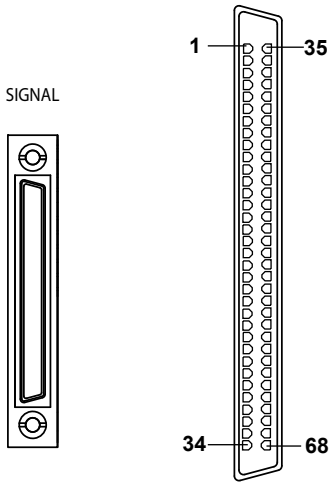
D-Sub 25-pin receptacle

Item	Specification
Connector type	D-SUB 25 pin
Maximum power output	28 W

Pin No.	Signal	Specifications	Pin No.	Signal	Specifications
1	PS1	5.250 V, 1 A/pin	14	GND	1 A/pin
2	PS1	5.250 V, 1 A/pin	15	GND	1 A/pin
3	PS2	3.465 V, 1 A/pin	16	GND	1 A/pin
4	PS2	3.465 V, 1 A/pin	17	GND	1 A/pin
5	PS2	3.465 V, 1 A/pin	18	GND	1 A/pin
6	PS2	3.465 V, 1 A/pin	19	GND	1 A/pin
7	PS3	1.890 V, 1 A/pin	20	GND	1 A/pin
8	PS3	1.890 V, 1 A/pin	21	GND	1 A/pin
9	PS4	–5.460 V, 1 A/pin	22	GND	1 A/pin
10	PS4	–5.460 V, 1 A/pin	23	GND	1 A/pin
11	PS4	–5.460 V, 1 A/pin	24	GND	1 A/pin
12	PS5	5.0 V, 1 A/pin	25	GND 1A/pin	
		3.3 V, 1 A/pin			
13	PS5	5.0 V, 1 A/pin			
		3.3 V, 1 A/pin			

Control/Monitor Signal Port (SIGNAL)

Use to configure the transceiver control signal or monitor the power supply voltage and status signals.



VHDCI 68-pin receptacle

Pin No.	Signal	I/O	Specification	Pin No.	Signal	I/O	Specification
1	GND	—	—	35	CTRL17(3.3V)	O	3.3 V CMOS
2	MDC	O	1.2 V CMOS	36	GND	—	—
3	GND	—	—	37	CTRL16(3.3V)	O	3.3 V CMOS
4	MDIO	I/O	1.2 V CMOS	38	GND	—	—
5	GND	—	—	39	CTRL15(3.3V)	O	3.3 V CMOS
6	GND	—	—	40	GND	—	—
7	GND	—	—	41	CTRL14(3.3V)	O	3.3 V CMOS
8	SCL	I/O	3.3 V CMOS	42	GND	—	—
9	GND	—	—	43	CTRL13(3.3V)	O	3.3 V CMOS
10	SDA	I/O	3.3 V CMOS	44	GND	—	—
11	GND	—	—	45	CTRL12(3.3V)	O	3.3 V CMOS
12	CTRL11(3.3V)	O	3.3 V CMOS	46	GND	—	—
13	GND	—	—	47	CTRL10(3.3V)	O	3.3 V CMOS
14	CTRL09(3.3V)	O	3.3 V CMOS	48	GND	—	—
15	GND	—	—	49	CTRL08(3.3V)	O	3.3 V CMOS
16	CTRL07(1.2V)	O	1.2 V CMOS	50	GND	—	—
17	GND	—	—	51	CTRL06(1.2V)	O	1.2 V CMOS
18	CTRL05(1.2V)	O	1.2 V CMOS	52	GND	—	—
19	GND	—	—	53	CTRL04(1.2V)	O	1.2 V CMOS
20	CTRL03(1.2V)	O	1.2 V CMOS	54	GND	—	—
21	GND	—	—	55	CTRL02(1.2V)	O	1.2 V CMOS
22	CTRL01(1.2V)	O	1.2 V CMOS	56	GND	—	—
23	GND	—	—	57	AIN06	I	—
24	AIN05	I	—	58	GND	—	—
25	AIN COM	—	—	59	AIN04	I	—
26	AIN03	I	—	60	AIN COM	—	—
27	AIN COM	—	—	61	AIN02	—	—
28	AIN01	I	—	62	AIN COM	—	—
29	APS R1	I	—	63	APS R1 COM	I	—
30	PS5 SENS	I	—	64	PS5 COM	I	—
31	PS4 SENS	I	—	65	PS4 COM	I	—
32	PS3 SENS	I	—	66	PS3 COM	I	—
33	PS2 SENS	I	—	67	PS2 COM	I	—
34	PS1 SENS	I	—	68	PS1 COM	I	—

Item	Specification
Connector type	SFF-8441 VHDCI 68 pin

3.8 SG Module

CAUTION

- Before removing modules from the frame controller, turn the output off.
- Before turning the frame controller off, turn the output off.
- Before connecting cables to or disconnecting cables from the I/O terminals, turn the output off.
- Before connecting cables to the I/O terminals, tighten the connectors at a specified torque using a torque wrench.
- Do not leave the REF OUT and 10 MHz REF OUT terminals open. Always terminate them with 50 Ω loads, such as the included terminators. Likewise, always terminate the cables that are connected to these output terminals with 50 Ω loads.
- Do not apply a signal that is greater than the specified maximum input voltage to the input terminals.
- Before connecting the unit to the DUT, turn the output off.
- Always use the specified connector to connect this module's I/O terminals. Using unspecified connectors to connect the I/O terminals may cause damage to the terminals and the connectors.
- When attaching connectors to the I/O terminals, always connect them straight, not at an angle. Attaching connectors to the I/O terminals at an angle may cause damage to the I/O terminals or the connectors' core wires.
- Do not apply external voltage to the output terminals.

Clock Signal Output (RF OUT CH1 to CH5)

Transmits a 622 MHz (output rate: 1/1) or 155 MHz (output rate: 1/4) clock signal.

Item	Specification
Connector type	SMA, female
Output amplitude	0.8 Vp-p ± 0.2 Vp-p, 1.3 Vp-p ± 0.2 Vp-p
Frequency	620.0 to 720.0 MHz (when the rate is 1/1)
	155.0 to 180.0 MHz (when the rate is 1/4)

External Synchronization Signal Input (10 MHz REF IN)

Apply a 10 MHz reference signal to this terminal to transmit a clock signal (RF OUT) that is synchronized with the applied signal.

Item	Specification
Connector type	SMA, female
Output amplitude	300 to 1200 mVp-p
Absolute max. rating	1.5 Vp-p
Frequency range	10 MHz ± 2.0 ppm

External Synchronization Signal Output (10 MHz REF OUT)

Transmits a 10 MHz reference signal for synchronizing an external signal with the clock signal (RF OUT).

Item	Specification
Connector type	SMA, female
Output amplitude	800 mVp-p ± 200 mVp-p
Frequency	10 MHz ± 2.0 ppm (when using the internal oscillator) Depends on the signal received by 10 MHz REF IN (when using an external reference signal)

4.1 Troubleshooting

Dealing with Unusual Circumstances

- If a message appears on the screen, see the following pages for reference.
- If servicing is necessary, or if the instrument does not operate properly even after you have attempted to deal with the problem according to the instructions in this section, contact your nearest YOKOGAWA dealer.

Problem	Probable Cause	Corrective Action	Reference Section
The instrument does not power on.	The power source is not connected.	Check that the frame controller's power cable is connected. If it is loose, connect it firmly.	Section 2.8
Cannot perform panel operations.	The instrument is in remote control mode.	If the LOCAL soft key is showing, the instrument is in remote control mode (through GP-IB for example). To perform panel operations, cancel remote control mode from the remote controller or press LOCAL to put the instrument into local mode.	Sections 1.1, 2.1, and 3.1 in IM 735101-17E
The laser beam is not generated. (Light source module)	The optical output is locked.	If the optical output is locked, "Lock" appears in the "Opt" box on the display. Unlock the laser output in the system settings. If you cannot unlock the laser output, an interlock connector plug may not be attached to the interlock connector on the rear of the frame controller. After you attach the plug, unlock the laser output.	
You cannot remember the password. (Light source module)		The default password is 1234. If you change the password, make sure that you change it to something that you will not easily forget.	
Unable to synchronize in PPG-ED loopback mode. (BERT module)	The cables are not connected.	Check that the cables are connected. If they are loose, connect them firmly.	Section 2.5
	The PPG Interface is not set to "Electric."	Check the PPG Interface setting. If it is set to "Optic," change it to "Electric."	Section 9.2 in IM 735101-03E and section 7.4 and page 4-2 in IM 735101-04E
	The input port settings are incorrect.	Check the input port settings (DATAIN1 and DATAIN2) of the ED against the actual connections. If the settings are different from the actual connections, change the settings to match the actual connections.	
	PPG output is not on.	Check the signal output. If the signal output is off, turn it on.	
	The PPG and ED settings (Pattern, PRBS length, Program length, Logic, etc.) do not match.	Check the DAT settings of the PPG and ED. If these settings do not match, change them so that they do.	
	The data amplitude is small.	Check the data amplitude value. If the amplitude is small, increase it.	
	The data threshold value is set to a value that would cause an error.	Check the data threshold value. If the threshold value is inappropriate, set it to an appropriate value.	
	The data and clock phases do not match when DATAIN2 is in use.	When using DATAIN2, you have to adjust the phase of the input clock using an external phase shifter. If the phase is not adjusted, use a phase shifter to adjust it.	
An error occurs in PPG-ED loopback mode. (BERT module)	The PPG and ED patterns do not match.	Check the PPG and ED patterns. If these patterns do not match, change them so that they do.	Section 9.2 in IM 735101-03E and section 7.4 and page 4-2 in IM 735101-04E
	Error-add is on.	Check the Error-add setting. If it is on, turn it off.	
	The data amplitude is small.	Check the data amplitude value. If the amplitude is small, increase it.	
	The data threshold value is incorrect.	Check the data threshold value. If the threshold value is inappropriate, set it to an appropriate value.	

Problem	Probable Cause	Corrective Action	Reference Section
The output waveform is not clear. (BERT module)	The cables are not connected well.	Check that the cables are connected. If they are loose, connect them firmly.	Section 2.5
	Unused output terminals are not terminated.	Check the output terminals. If they are open, terminate them using the supplied terminators.	Section 2.5
	The cables or connectors in use do not have good high-frequency characteristics.	Check the cables and connectors. If they do not have good high-frequency characteristics, replace them with cables or connectors that do.	-
The LOS alarm appears on the OE. (10 Gbit/s optical modulator)	The end face of the optical fiber is dirty.	Check the end face of the optical fiber. If it is dirty, clean it.	Section 2.7
	The optical fiber is not connected.	Check that the optical fiber is connected. If it is loose, connect it firmly.	
	The optical input power of the OE is less than the minimum light receiving sensitivity.	Check the optical power of the input signal. If it is less than the minimum light receiving sensitivity, insert optical AMPs into the system.	-
	The LD light source output is off.	Check the LD light source output. If it is off, turn it on.	-
	The output power setting of the LD light source is too low.	Check the output power setting of the LD light source. If it is too low, set it to an appropriate level.	-
The OVERLOAD alarm appears on the OE. (10 Gbit/s optical modulator)	The optical input power of the OE is too large.	Check the optical power of the input signal. If it is too large, insert optical ATTs into the system for protection.	-
Sync loss errors occur. (10 Gbit/s optical modulator and receiver)	The PPG Interface is not set to “Optic.”	Check the PPG Interface setting. If it is set to “Electric,” change it to “Optic.”	Section 9.2 in IM 735101-03E and section 7.4 in IM 735101-04E
	OE output is not on.	Check the OE data output. If it is off, turn the output on.	
	The optical input power of the OE is not within the light receiving range.	Check the optical power of the input signal. If it is not within the light receiving range, insert optical ATTs or optical AMPs so that the optical power of the input signal enters the light receiving range.	-
	The wavelength bands of the LD and EO do not match.	Check the wavelength bands of the LD and EO. If they do not match, use instruments that have matching wavelength bands. Use the AQ2200-621 at the 1.5 μm band and the AQ2200-622 at the 1.3 μm band.	-
	The polarization direction of the PMF that connects the LD and EO is incorrect.	Use a PMF with the /P option.	Section 2.5
	The logic settings of the PPG and ED conflict with the ABC slope settings of the EO.	Set all the settings to “Positive” to check the operation.	Section 9.2 in IM 735101-03E and section 7.4 in IM 735101-04E
	The OE data threshold value is incorrect.	Check the OE data threshold value. If the threshold value is inappropriate, set it to an appropriate value.	

Inspecting the BERT Module

You can perform an inspection of the BERT module by testing some of its specifications.

Recommended Test Instruments

The following table shows the measuring instruments that are necessary for carrying out performance tests.

You may use other instruments, provided that they perform better than the instruments listed here.

Recommended Test Instruments

Product Name	Required Performance	Recommended Device
Digital oscilloscope	Digital Communications Analyzer Dual Channel 50 GHz Electrical Plug-In Module	Agilent 86100A Agilent 83484A
Phase shifter	3.5 mm connector type	Hirose Electric HLS-JJ-13
Attenuator	10 dB (3.5 mm connector type) 20 dB (3.5 mm connector type)	INMET 41KC-10 INMET 41KC-20
Coaxial cable	3.5 mm connector type SMA connector type	

BER Measurements (With clock recovery)

This test inspects whether the SG-PPG-ED (CDR) module is operating properly by looping the signal from the PPG back to the ED and performing BER measurements.

- **Procedure**

  1. Insert a 10 dB attenuator in the DATAIN1 terminal (with built-in CDR) of the AQ2200-601 10 Gbit/s BERT module's ED, and use a coaxial cable to connect this terminal to the DATA OUT terminal of the PPG.

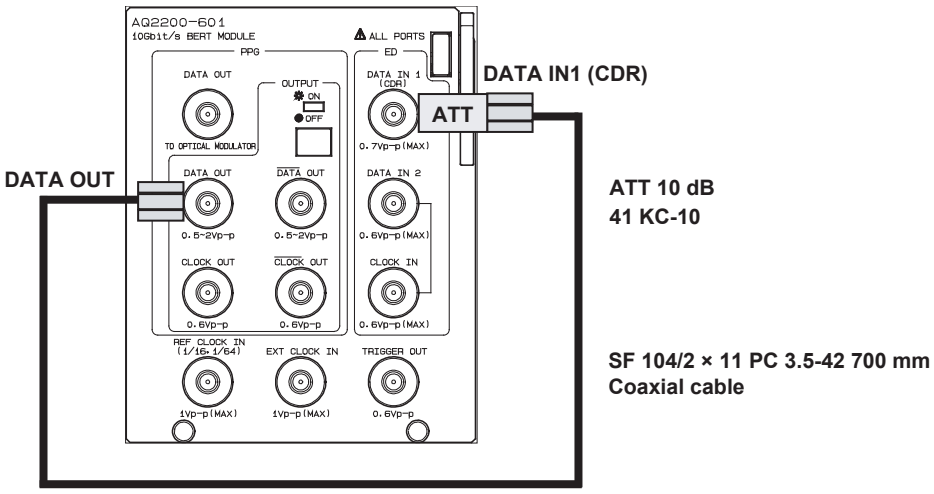
  2. Configure the AQ2200-601 10 Gbit/s BERT module as follows:

PPGIF:	Electric	Setup:	Couple
Data offset:	0.00 V	Pattern:	PRBS
Data cross point:	50%	PRBS length:	PRBS31
Clock source:	Internal	Error mode:	Single
Bitrate:	11.32Gbit/s	Logic:	Positive
Bitrate offset:	0ppm	Meas mode:	Single
Clock offset:	0.00V	Meas day:	0 day
Input select:	DataIn 1(CDR)	Meas time:	5 min
Data threshold:	0mV	Disp mode:	Current
Auto sync:	ON		

  3. Set the instrument's data amplitude to 0.5 V, and perform the BER measurement. Check that no errors occur for five minutes.

  4. In the same way, set the data amplitude to 2.0 V, and perform the BER measurement. Check that no errors occur for five minutes.

- **Connection Diagram**



BER Measurements (Without clock recovery)

This test inspects whether the SG-PPG-ED (without CDR) module is operating properly by looping the signal from the PPG back to the ED and performing BER measurements.

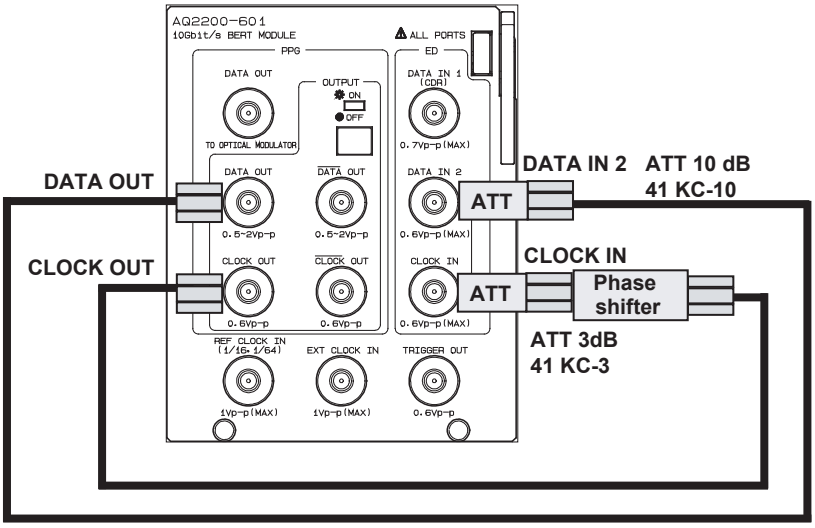
- **Procedure**

  1. Insert a 10 dB attenuator in the DATAIN2 terminal (without CDR) of this instrument's ED, and use a coaxial cable to connect this terminal to the DATA OUT terminal of the PPG.
  2. Insert a phase shifter into the CLOCK IN terminal of this instrument's ED, and use a coaxial cable to connect this terminal to the CLOCK OUT terminal of the PPG.
  3. Configure the AQ2200-601 10 Gbit/s BERT module as follows:

PPGIF:	Electric	Setup:	Couple
Data offset:	0.00V	Pattern:	PRBS
Data cross point:	50%	PRBS length:	PRBS31
Clock source:	Internal	Error mode:	Single
Bitrate:	10.71Gbit/s	Logic:	Positive
Bitrate offset:	0ppm	Meas mode:	Single
Clock offset:	0.00V	Meas day:	0 day
Input select:	DataIn 2	Meas time:	5 min
Data threshold:	0mV	Disp mode:	Current
Auto sync:	ON		

  4. Set the instrument's data amplitude to 0.5 V, and perform the BER measurement. Check that no errors occur for five minutes.
  5. In the same way, set the data amplitude to 2.0 V, and perform the BER measurement. Check that no errors occur for five minutes.

- **Connection Diagram**



If the Problem Cannot Be Resolved

If the cause of the problem cannot be located, or if the instrument cannot be returned to its original state, contact your nearest YOKOGAWA dealer.
Check the following before you contact your nearest YOKOGAWA dealer.

1. **Instrument Name**
   The instrument name is shown on the nameplate that is on the rear of the frame controller or on the side of a module.
2. **Frame Controller Firmware Version**
   Check the firmware version of the frame controller by selecting “Information” from the menu on the SYSTEM screen.
3. **Each Module’s Firmware Version**
   Check the firmware version of each module by pressing the Information soft key.
4. **Conditions That the Problem Occurs Under**
   - What sort of environment are you using the instrument in?
     Indoors or outdoors, temperature, how many modules are installed, etc.
   - What happened? What were you doing at the time?
     Example: The instrument froze when I was operating it from the panel or through remote control.
   - What settings were you using?
   - What messages appeared on the display?
     Display screen, error messages, etc.
5. **Date and Time That the Problem Occurred**

4.2 Error Messages

Error Messages

Messages may appear on the screen while you are using this instrument. This section describes the error messages and the corrective action to take. If the corrective action states that serving is required, contact your nearest YOKOGAWA dealer. In addition to the messages listed here, other communication-related error messages may also appear. These error messages are described in the *Communications Interface User's Manual (IM 735101-17E)*.

Frame Controller

Code	Error Message	Description	Corrective Action
600	File System Error	The file system is corrupt.	Try again with a different USB memory device. If the same message continues to appear, servicing is required.
649	Unknown file or folder	The specified file or folder cannot be found.	Check the file or folder name.
678	USB memory can not be recognized	The instrument could not detect the USB memory.	Contact your nearest YOKOGAWA dealer for details on what USB memory devices have been confirmed to work with the instrument.
729	Module Not Implement	The module that you are trying to load the file into is not installed.	Install the module that you are trying to load the file into.
730	File Sum Check Error	The file may be corrupt. Alternatively, the instrument could not load a setup file that was saved on an AQ2201/AQ2202 frame controller.	Recreate the file that you are trying to load. You cannot load setup files that were saved on an AQ2201/AQ2202 frame controller. Create setup files on an AQ2211/AQ2212 frame controller.
731	File Alredy Exist	The same file already exists.	Check the file that you are trying to load. If you are sure, delete the already existing file.
732	File Open Error	The file could not be loaded. The file may be corrupt.	Recreate the file that you are trying to load.
733	Module Type Error	The module type stored in the file that you are trying to load is not the same as the installed module type.	Make the module type stored in the file that you are trying to load the same as the installed module type.
734	Illegal Parameter	There is an invalid module setting in the file that you are trying to load.	Use a file that contains valid module settings.
735	Product Error	The module product name stored in the file that you are trying to load is not the same as the product name of the installed module.	Make the module product name stored in the file that you are trying to load the same as the model product name of the installed module.
736	Option Error	The module option information stored in the file that you are trying to load is not the same as the option information of the installed module.	Make the module option information stored in the file that you are trying to load the same as the model option information of the installed module.
737	Software Version Error	The module software version stored in the file that you are trying to load is not the same as the software version of the installed module.	Make the module software version stored in the file that you are trying to load the same as the software version of the installed module.
738	File Size Error	The data size of the file that you are trying to load is invalid.	You cannot load setup files that were saved on an AQ2201/AQ2202 frame controller. Create setup files on an AQ2211/AQ2212 frame controller.
741	Module Error	The module type stored in the file that you are trying to load is invalid.	Use a file that contains a valid module type.
742	Format Verion Error	The format version stored in the file that you are trying to load is not the same as the format version of the installed module.	Make the format version stored in the file that you are trying to load the same as the format version of the installed module.
743	SG Module Error	The SG module that you are trying to load the file into is not installed.	Install the SG module that you are trying to load the file into.

Code	Error Message	Description	Corrective Action
744	ATTN Module Error	The ATTN module that you are trying to load the file into is not installed.	Install the ATTN module that you are trying to load the file into.
745	Data Size Error	The data cannot be saved because it is too large.	When you are saving a measured result in CSV format, the maximum file size is 65,536 lines. Divide the measured result so that each file is within the maximum file size.
746	File Name Error	The same file name already exists.	Save the file with a different name.
747	File Delete Error	The file may be corrupt.	Try again with a different USB memory device. If the same message continues to appear, servicing is required.
748	File Log File Error	More than 999 files that have automatically generated file names have been saved.	You can only save 999 files that have automatically generated file names. When you are logging, divide and save the log data so that the number of files does not reach this limit.
919	Hardware failed, and needs to be repaired. Please contact Yokogawa's representatives.	The system is malfunctioning.	Servicing is required.
920	Incorrect date and time setting. Set the correct date and time	The date and time settings are incorrect.	Configure the date and time correctly.
921	The writing processing to the EEPROM failed	The system is malfunctioning.	Servicing is required.
992	Cannot Operate During Measuring	The instrument cannot be operated while measurements are being performed.	Operate the instrument after the measurements finish.
993	Cannot Operate During Zero Set	The instrument cannot be operated while the zero-set procedure is ongoing.	Operate the instrument after the zero-set procedure finishes.
994	Cannot Operate During Updating	The instrument cannot be operated while it is being updated.	Operate the instrument after the updates finish.
995	Device Already In Use	The modules that you intend to use in the ORL application were not selected correctly.	Check the modules that you intend to use.
997	Application Internal Error	The system is malfunctioning.	Servicing is required.
998	Sequence Conflict	The instrument received a command while it was still processing the previous one.	Transmit commands after the processing of the previous command finishes.
999	Command Not Found	The system is malfunctioning.	Servicing is required.
1000	FAN Alarm	The fan has stopped.	Restart the instrument. If the same message continues to appear, servicing is required.
1002	Password Error	The entered password is incorrect.	Confirm that the password is correct, and then re-enter it.
1003	Slot Empty	The specified slot is empty.	Check whether a module is installed in the specified slot.
1007	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1008	Memory Check Error	An error occurred during the start-up memory error check.	Restart the instrument. If the same message continues to appear, servicing is required.
1010	No Media	Storage medium (USB memory device) is not attached.	Attach the storage medium.
1011	Media Full	There is not enough space to write to the storage medium (USB memory device).	Delete files to increase the amount of free space on the storage medium, or switch to a different storage medium that has more space.
1012	Corrupt Error	The storage medium (USB memory device) may be damaged. Additionally, there may be too many files on the storage medium. If the format of the storage medium is FAT, there is a limit to the number of files it can store.	Delete files to decrease the number of files on the storage medium, or switch to a different storage medium that has more space.
1013	USB Host Error	The remote PC is malfunctioning.	Change the remote PC.

4.2 Error Messages

Code	Error Message	Description	Corrective Action
1014	Soft Version Error	There is a discrepancy between the version of the firmware installed in the frame controller and the firmware installed in the module.	Update the firmware on the frame controller and the module. Contact your local YOKOGAWA dealer for the latest version of the firmware.
1015	Module Type Error	The frame controller can not detect the module.	Update the firmware on the frame controller. Contact your local YOKOGAWA dealer for the latest version of the firmware.

Note

Error codes 1020 to 1099 are remote command errors. These error messages are described in the *Communications Interface User's Manual (IM 735101-17E)*.

Light Source Module

Code	Error Message	Description	Corrective Action
1100	LS Lock	Laser output is locked.	Attach an interlock connector to the rear of the frame controller. If the same message continues to appear, set Lock to Off on the frame controller's SYSTEM screen.
1101	Temperature Error	The temperature inside the module is too high.	Turn the power off, and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1102	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1104	Light Output Limit Operation1	The optical output of the light source (device 1) has exceeded its upper limit.	Restart the instrument. If the same message continues to appear, servicing is required.
1105	Memory Check Error	An error occurred during the start-up memory check.	Restart the instrument. If the same message continues to appear, servicing is required.
1106	Thermistor Temperature Error1	The thermistor detected a temperature error. (For laser light source 1.)	Restart the instrument. If the same message continues to appear, servicing is required.
1107	Thermistor Temperature Error2	The thermistor detected a temperature error. (For laser light source 2.)	Restart the instrument. If the same message continues to appear, servicing is required.
1108	PEL Over current Error1	The Peltier current is abnormal. (For laser light source 1.)	Restart the instrument. If the same message continues to appear, servicing is required.
1109	PEL Over current Error2	The Peltier current is abnormal. (For laser light source 2.)	Restart the instrument. If the same message continues to appear, servicing is required.
1110	Temperature Limit Error	The internal temperature is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1111	Opt Lock Error	Laser output is locked. Optical output cannot be turned on.	Unlock the laser output. For details see section 4.1, "Troubleshooting." If the same message continues to appear, servicing is required.
1112	Light Output Limit Operation 2	The optical output of the light source has exceeded its upper limit.	Restart the instrument. If the same message continues to appear, servicing is required.

Grid TLS Module (Available in firmware versions 3.00 and later)

Code	Error Message	Description	Corrective Action
1111	Opt Lock Error	Laser output is locked. Optical output cannot be turned on.	Unlock the laser output. For details see section 4.1, "Troubleshooting." If the same message continues to appear, servicing is required.
1170	Module ExecutionError	The internal optical module is not operating.	Restart the instrument. If the same message continues to appear, servicing is required.
1172	Module Temperture Error	The temperature inside the internal optical module is too high.	Turn the power off. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1175	Module Communication Error	Communication error with the internal optical module.	Restart the instrument. If the same message continues to appear, servicing is required.
1177	Temperture Error	The temperature inside the module is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1178	Module Frequency Error	The specified frequency and the laser output frequency are different.	Restart the instrument. If the same message continues to appear, servicing is required.
1179	Module Power Error	The specified power value and the laser output power are different.	Restart the instrument. If the same message continues to appear, servicing is required.
1180	Module Fatal Error	Internal optical module error.	Restart the instrument. If the same message continues to appear, servicing is required..
1182	Module Voltage Error	The internal voltage is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.

TLS Module

Code	Error Message	Description	Corrective Action
1130	Temperature Error	The temperature inside the module is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1131	Update Error	A failure occurred during a software update.	If the same message continues to appear even after you restart the instrument, servicing is required.
1133	TEC Temperature Error	The thermistor detected a temperature error.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1134	TEC Over Current Error	The thermistor drive current is abnormal.	If the same message continues to appear even after you restart the instrument, servicing is required.
1135	TEC Driver Temperature Error	The thermistor driver detected a temperature error.	If the same message continues to appear even after you restart the instrument, servicing is required.
1136	LD Over Current Error	The LD drive current is abnormal.	If the same message continues to appear even after you restart the instrument, servicing is required.
1137	TLS EL Error	A TLS end limit error occurred.	If the same message continues to appear even after you restart the instrument, servicing is required.
1138	TLS Initialization Error	A failure occurred during initialization.	If the same message continues to appear even after you restart the instrument, servicing is required.
1139	TLS WL Caribration Error	An error occurred during wavelength calibration.	Leave the optical output turned on for at least 30 minutes to warm up the instrument. If the same message continues to appear, restart the instrument. If the same message continues to appear even after you restart the instrument, servicing is required.
1135	TEC Driver Temperature Error	The thermistor driver detected a temperature error.	If the same message continues to appear even after you restart the instrument, servicing is required.
1140	APC PD Feed Back Error	The photodiode's automatic power control is malfunctioning.	If the same message continues to appear even after you restart the instrument, servicing is required.
1141	Gas Cell PD Feed Back Error	The wavelength calibration system that uses the internal gas cell is malfunctioning.	If the same message continues to appear even after you restart the instrument, servicing is required.
1151	ATT EL Error	The internal attenuator is malfunctioning.	If the same message continues to appear even after you restart the instrument, servicing is required.
1152	ATT Initialization Error	A failure occurred during the initialization of the internal attenuator.	If the same message continues to appear even after you restart the instrument, servicing is required.
1153	OSW Switching Error	The internal optical switch is malfunctioning.	If the same message continues to appear even after you restart the instrument, servicing is required.
1157	Wavelength Over Error	A wavelength was set that does not fall within the settable range.	Check the wavelength. Set the wavelength to a value that falls within the settable range.
1159	LD is inactive	The optical output is not active.	Turn the optical output on.
1160	Temperature Limit Error	The temperature inside the module is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1161	Memory Check Error	The internal memory is malfunctioning.	If the same message continues to appear even after you restart the instrument, servicing is required.
1162	Opt Lock Error	The optical output is locked.	Unlock the optical output.
1163	Sweep Parameter Error1	The sweep start wavelength is larger than the sweep stop wavelength.	Check the sweep start wavelength, and set it again.
1164	Sweep Parameter Error2	The number of sweep steps is 20001 or more in the Swept application.	Set the number of sweep steps to a value less than or equal to 20000.
1165	Sweep Parameter Error3	The sweep speed is set to a speed at which sweeps cannot be performed.	Check the sweep speed, and set it again.

Sensor Module

Code	Error Message	Description	Corrective Action
1200	Memory Check Error	An error occurred during the memory check.	Restart the instrument. If the same message continues to appear, servicing is required.
1201	Flash Rom Write Error	An error occurred during writing to the flash ROM.	Restart the instrument. If the same message continues to appear, servicing is required.
1202	Header Error	The sensor head type could not be detected correctly.	Restart the instrument. If the same message continues to appear, servicing is required.
1203	Temperature Error	The internal temperature is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1204	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1206	No Head	The sensor head is not connected.	Check that the sensor head is firmly connected.
1207	Temperature Limit Error	The internal temperature is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1260	PD Module Error1	The Peltier temperature is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1261	PD Module Error2	The Peltier current is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1262	PD Module Error3	The Peltier control IC temperature is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1263	Zero set Error1	Light was not cut off during the zero-set procedure.	After checking that light can be cut off, execute the zero-set procedure again.
1264	Zero set Error2	There is a problem with the hardware.	Reset the instrument, and then execute the zero-set procedure. If the same message continues to appear, servicing is required.
1265	OPT Mode Error	An optical signal was applied that has a frequency that is different from the frequency that was set in CHOP mode.	Check the CHOP frequency settings.
1266	Input Power Over	An optical signal was applied that exceeds the maximum optical input level.	Set the optical input power to a value that is less than or equal to the maximum optical input level.
1267	Range Over	The optical input level is higher than the upper limit of the measurement range.	Adjust the measurement range so that the range bar on the Detail screen of the frame controller's sensor module becomes black. When the Range Over error occurs, the range bar is orange.
1268	A/D Read Error	There is a problem with the sensor module hardware.	Restart the instrument. If the same message continues to appear, servicing is required.
1269	Trigger Ignored	A remote measurement command was received during trigger input mode.	Check the measurement mode.

OSW Module

Code	Error Message	Description	Corrective Action
1401	Temperature Error	The internal temperature is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1402	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1405	Memory Check Error	An error occurred during the memory check.	Restart the instrument. If the same message continues to appear, servicing is required.
1406	Temperature Limit Error	The internal temperature is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1407	Over Current Error	The module's drive current is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.

ATTN Module

Code	Error Message	Description	Corrective Action
1301	Temperature Error	The internal temperature is too high.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1302	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1304	Initialization Error	A failure occurred during initialization.	Restart the instrument. If the same message continues to appear, servicing is required.
1305	Memory Check Error	An error occurred during the memory check.	Restart the instrument. If the same message continues to appear, servicing is required.
1306	Temperature Limit Error	The internal temperature is abnormal.	Turn the power off and confirm that the frame controller's inlet and exhaust holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1307	Over Current Error	The module's drive current is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.
1363	Zero set Error1	Light was not cut off during the zero-set procedure.	After checking that light can be cut off, execute the zero-set procedure again.
1364	Zero set Error2	There is a problem with the hardware.	Reset the instrument, and then execute the zero-set procedure. If the same message continues to appear, servicing is required.
1365	Input Power Over	An optical signal was applied that exceeds the maximum optical input level.	Set the optical input power to a value that is less than or equal to the maximum optical input level.

XFP Interface Module

Code	Error Message	Description	Corrective Action
1600	Memory Check Error	An error occurred during the start-up memory check.	Restart the instrument. If the same message continues to appear, servicing is required.
1601	Flash Rom Write Error	An error occurred during writing to the flash ROM.	Restart the instrument. If the same message continues to appear, servicing is required.
1603	Temperature Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1604	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1605	Not Running	The XFP interface module is not running.	Restart the instrument. If the same message continues to appear, servicing is required.
1607	Temperature Limit Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1660	I2C Communication Error	A CRC or NAK error was detected during communication with the XFP optical transceiver.	Check that the XFP optical transceiver is installed correctly. If the same message continues to appear, servicing is required.
1661	No XFP Module	An XFP optical transceiver is not installed.	Install an XFP optical transceiver into the XFP interface module.
1662	Opt Lock Error	The optical output is locked.	Unlock the optical output.
1663	XFP Power Voltage Error	The power that is being supplied to the XFP optical transceiver is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.
1664	Password Error	The entered password is incorrect, or the specified page cannot be selected.	Check the password or page, and then re-enter the correct password or page.

Transceiver I/F Module

Code	Error Message	Description	Corrective Action
1700	Temperature Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1701	Temperature Limit Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1702	I2C I/F Error I2C	The communication mode is not set properly.	Set the connected optical transceiver and the clock values to the same value.
1703	TRN Invalid Cal Data	The calibration data is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.
1704	Flash Rom Write Error	An error occurred during writing to the flash ROM.	Restart the instrument. If the same message continues to appear, servicing is required.
1705	Not Running	The Transceiver I/F module is not running.	Restart the instrument. If the same message continues to appear, servicing is required.
1706	PS1 Overload	The PS1 power supply current has exceeded the limit.	Check the current consumption of the connected optical transceiver, and set a new current limit. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.
1707	PS2 Overload	The PS2 power supply current has exceeded the limit.	Check the current consumption of the connected optical transceiver, and set a new current limit. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.
1708	PS3 Overload	The PS3 power supply current has exceeded the limit.	Check the current consumption of the connected optical transceiver, and set a new current limit. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.
1709	PS4 Overload	The PS4 power supply current has exceeded the limit.	Check the current consumption of the connected optical transceiver, and set a new current limit. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.
1710	PS5 Overload	The PS5 power supply current has exceeded the limit.	Check the current consumption of the connected optical transceiver, and set a new current limit. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.
1711	MDIO I/F Error	An error occurred during MDIO communication.	Check that the optical transceiver is connected correctly.
1712	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
1713	Total Overload	The total optical transceiver current consumption has exceeded the upper limit.	Set a new limit value that matches the current consumption of the connected optical transceiver. Make sure that the total current consumption for PS1 to PS5 is 28 W or less.

SG Module

Code	Error Message	Description	Corrective Action
1800	Temperature Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1801	Temperature Limit Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
1802	Not Running	The SG module is not running.	Restart the instrument. If the same message continues to appear, servicing is required.
1803	SG Invalid Cal Data	The calibration data is abnormal.	Restart the instrument. If the same message continues to appear, servicing is required.
1804	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.

10Gbit/s BERT Module

Code	Error Message	Description	Corrective Action
2011	Command Error	Commend error	Check the command and send it again.
2012	Range Error	A parameter was set that does not fall within the settable range.	Check the parameter. Set the wavelength to a value that falls within the settable range.
2013	RAM Write Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
2014	Serial Error	Serial communication error	Restart the instrument. If the same message continues to appear, servicing is required.
2015	Parameter Error	Parameter error	Check the command parameters and send the command again.
2016	Syntax Error	Syntax error	Check the syntax and send the command again.
2017	Temperature Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
2018	Temperature Limit Error	The internal temperature is too high.	Turn the power off, and confirm that the frame controller's ventilation holes are not blocked. After waiting for some time, restart the instrument. If the same message continues to appear, servicing is required.
2021	Not Running	The BERT module is not running.	Restart the instrument. If the same message continues to appear, servicing is required.
2031	Invalid update memory	Update Memory of the Firmware is faulty.	Update the firmware again.
2032	Invalid ID information Memory	Update Memory of the Firmware is faulty.	Hardware is faulty. Servicing required.
2033	SG Initialize Unlock	Unlock error occurs at start-up.	Hardware is faulty. Servicing required.
2034	FPGA configuration error	Configuration of the FPGA is failed.	Hardware is faulty. Servicing required.
2035	A/D Timeout Error	An A/D timeout error occurred.	Restart the instrument. If the same message continues to appear, servicing is required.
2061	Fatal Error	The command is irregular.	Check the command, and enter it again.
2062	Hardware Missing	This module does not support the /M or /P1 option.	Use a module that supports these options.
2063	Measure State Error	Error caused by unstable measurement status as described below. •:`INIT:CONT ON` or `:TRIG:SOUR` is received during measurement. •:`TRIG:IMM` is received when `:INIT:CONT` is set at OFF.	Send the command in the correct status.
2064	Program load Error	The instrument was unable to load the program data.	Check the path of the file that you are trying to load. Specify the file with the absolute path. Also, enter “/USB-0/” at the start of the path.
2065	Module work in proccess	The module is performing another process.	Enter the command again after waiting for some time.
2066	Media Error	The medium may be corrupt.	Try again with a different USB memory device. If the same message continues to appear, servicing is required.
2067	Update Error	A failure occurred during a firmware update.	Restart the instrument. If the same message continues to appear, servicing is required.
2068	File Not Found	The specified file does not exist.	Specify a correct file name.
2069	Invalid File	An invalid file is selected.	Check the contents of the file.
2070	Setting Conflict	The device cannot execute the command.	Check the state of the device.

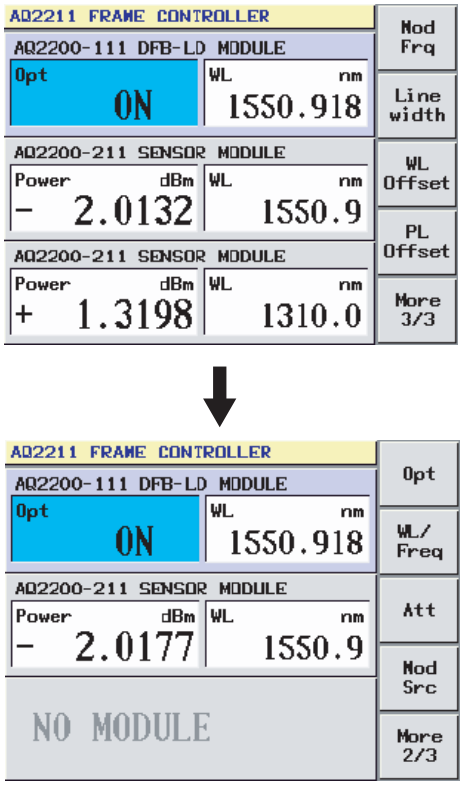
4.3 Changing Modules

You can install and uninstall modules while the frame controller is on.

Uninstalling a Module

You can uninstall modules while the instrument is on.

1. Uninstall the module that is installed in slot 3.



Note

When you remove the module while displaying a screen other than the DETAIL or SUMMARY screen, the screen closes and the DETAIL or SUMMARY screen appears.

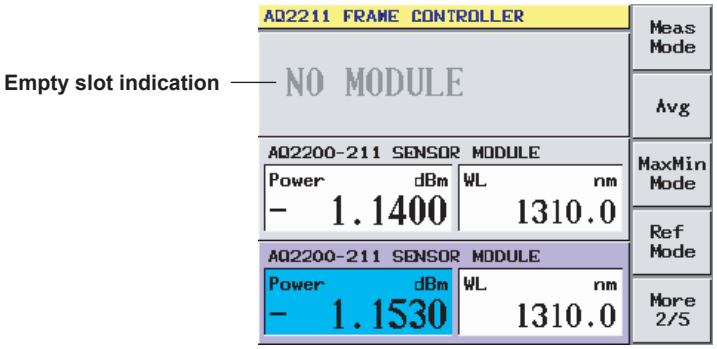
Installing a Module

You can install modules while the instrument is on.

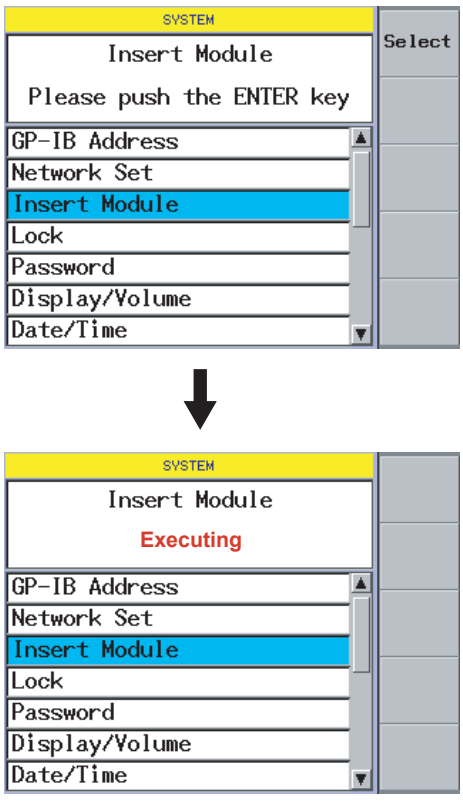
When a module is installed, the instrument automatically detects it.

If the module is not automatically detected, follow the procedure below to force the instrument to detect the installed modules.

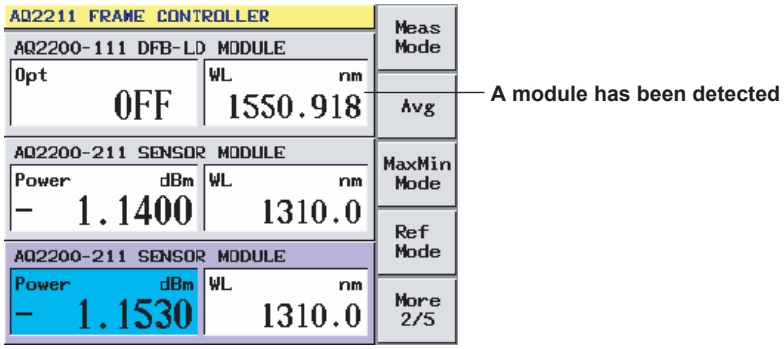
1. Install the module in an empty slot.



2. Press **SYSTEM** to display the SYSTEM screen.
3. Use the arrow keys to select Insert Module, and press the **Select** soft key or **ENTER**. The instrument starts detecting the installed modules, and "Executing" appears at the top of the screen. "Executing" disappears when the instrument finishes detecting the installed modules.



After the instrument finishes detecting the modules, the DETAIL or SUMMARY screen appears.



Note

- An error message may appear immediately after the instrument finishes detecting the installed modules.
  This error shows that, due to a discrepancy between the release version of the firmware installed in the frame controller and the firmware installed in the module, there is a possibility that some operations may not work properly.
  Please update the firmware if this error appears.
- The instrument takes approximately 5 seconds to automatically detect modules after they have been installed in the frame controller.
- When you remove the module while displaying a screen other than the DETAIL or SUMMARY screen, the screen closes and the DETAIL or SUMMARY screen appears.

4.4 Updating the Firmware

CAUTION

- After you update the firmware on an instrument, all of its settings are reset to their initial values.
  Where necessary, save the settings before you update the firmware.
- If you do not comply with the following precautions you will not be able to restart the instrument.
  - Do not turn the instrument off, install or uninstall modules, or connect or disconnect USB memory devices while the firmware is being updated.
  - Do not decode or modify the files that are used to update the firmware.
  - Always update the firmware to the most recent version.

Procedure

Updating the Frame Controller Firmware

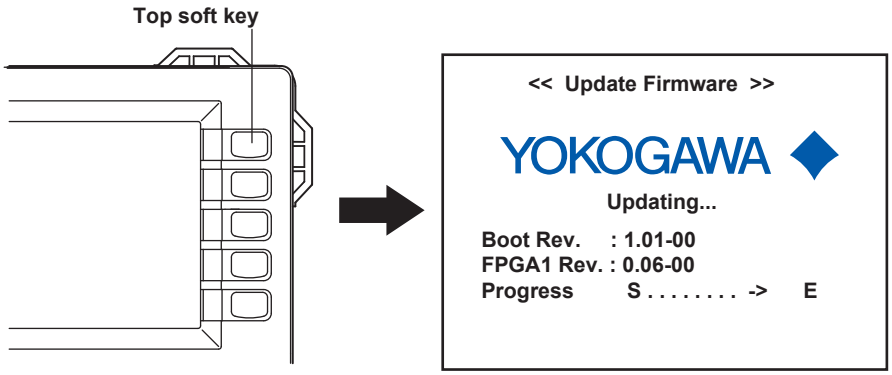
Update Procedure

1. Turn the frame controller off.
2. Connect a USB memory device that contains the most recent version of the firmware to the front of the frame controller.

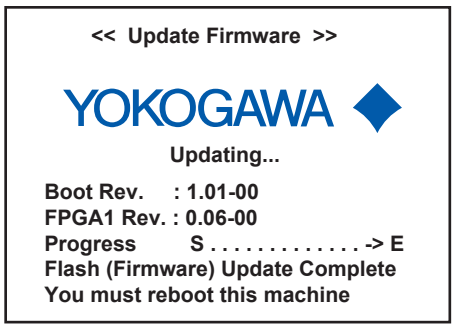
Note

- Connect the USB memory device directly, not through a USB hub.
- Name the update file as “aq221xlz.bin,” and place the file in the root directory of the USB memory.

3. Turn the instrument on while holding down the top soft key.
   The update screen appears, and the instrument begins updating the firmware automatically.



4. A completion message appears at the bottom of the screen when the update finishes correctly. After that, the frame controller starts automatically.



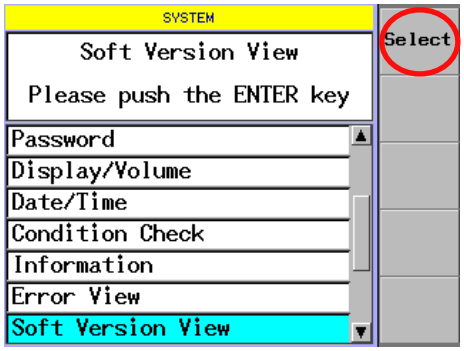
Note

You can disconnect the USB memory device when the frame controller starts to run.

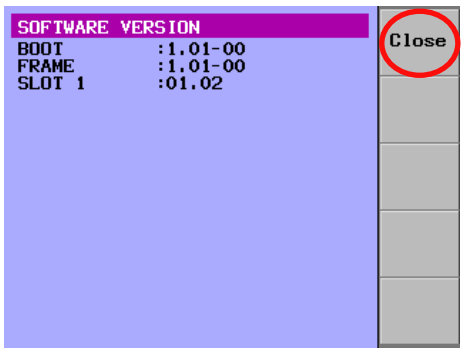
Displaying the Version Information

1. Press **SYSTEM** to display the SYSTEM screen.
2. Use the arrow keys to select Soft Version View, and press the **Select** soft key or **ENTER**.

   The SOFTWARE VERSION screen appears. This screen shows the version information for the frame controller and all of the installed modules.



3. Press the **Close** soft key to close the SOFTWARE VERSION screen.



Updating the Module Firmware

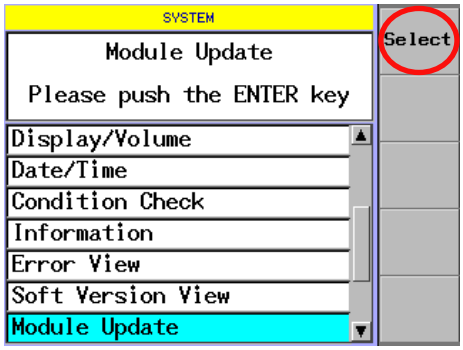
Update Procedure

1. Connect a USB memory device that contains the most recent version of the firmware to the front of the frame controller.

Note

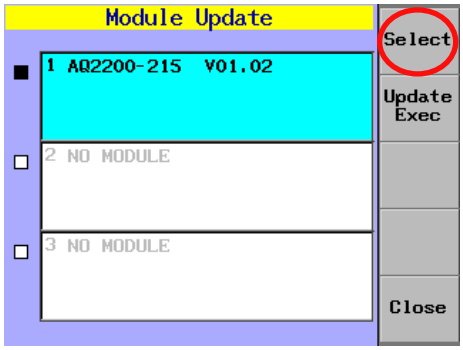
- Connect the USB memory device directly, not through a USB hub.
- Do not change the name of the update file.
- Place the update file in the “module” folder on the USB memory.

2. Press **SYSTEM** to display the SYSTEM screen.
3. Use the arrow keys to select Update, and press the **Select** soft key or **ENTER**. The Module Update screen appears. The following explanation is for the screen that is displayed on the AQ2211. On the AQ2212, you can scroll the screen to display the modules that are installed in the nine slots.

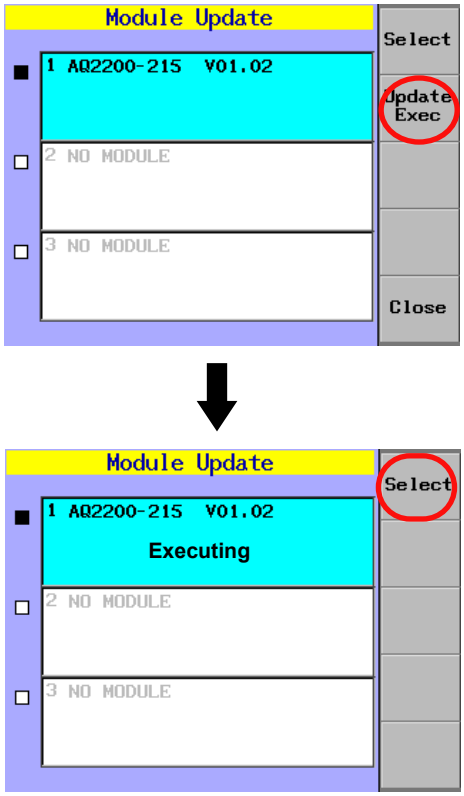


4. Use the arrow keys to select a module that you want to update, and press the **Select** soft key or **ENTER**. The check boxes for all the modules that you have selected are displayed in black.

Module selection screen (AQ2211)



5. Press the **Update Exec** soft key to update the firmware for the selected modules.



Note

If you select multiple modules to update, the progress indication is updated for each module. One of the following four progress indications is displayed.

- Executing: The firmware update is being executed.
- File Not Found: The USB memory device does not have the files that are required to update the module.
- Failed: The firmware update failed.
- Complete: The firmware update completed successfully.

6. After the firmware finishes updating, the message “Please Restart System” is displayed. Restart the frame controller.

Displaying the Version Information

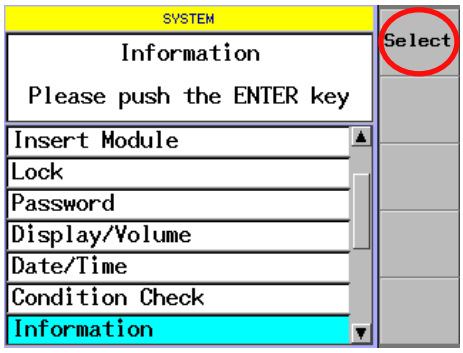
The procedure to display the version information is the same as that given for the frame controller. See page 4-15.

Displaying Instrument Information

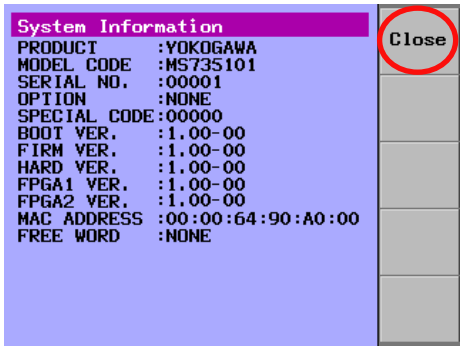
Displaying Frame Controller Information

You can display the frame controller's hardware and firmware information.
Follow the steps below to display this information.

1. Press **SYSTEM** to display the SYSTEM screen.
2. Use the arrow keys to select Information, and press the **Select** soft key or **ENTER**. The System Information screen appears.



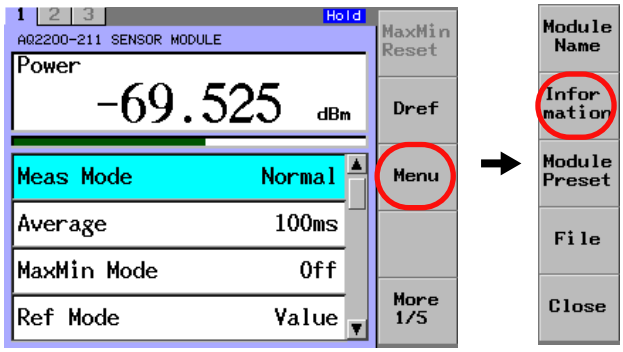
3. After checking the information, press the **Close** soft key.



Displaying Module Device Information

You can display the device information for the installed modules.

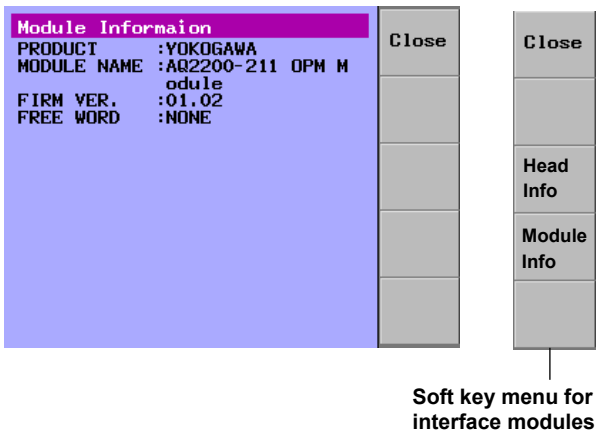
1. Press **SLOT**, and select the module that you want to display device information for.
2. Press the **Menu** soft key to display the module control soft keys.



Note

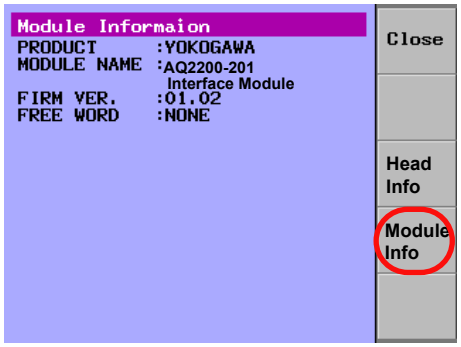
You can carry out this procedure to display the module information for AQ2200-1xx, AQ2200-2xx, AQ2200-3xx, and AQ2200-4xx modules. You cannot carry out this procedure to display the module information for AQ2200-6xx modules.

3. Press the **Information** soft key to display the Module Information screen. The display will be slightly different depending on the installed modules.



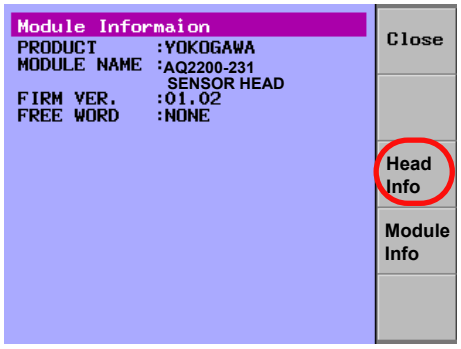
- **Displaying Interface Module Device Information**

4. Press the **Module Info** soft key to display the Module Information screen.



- **Displaying Sensor Head Device Information**

5. Press the **Head Info** soft key to display the Head Information screen.



Note

If a sensor head is not connected, the Head Info soft key is dimmed and cannot be pressed.

6. After checking the information, press the **Close** soft key.

Explanation

Firmware Updates

This instrument may require firmware version updates to support new modules and new or modified features.

How to Obtain the Firmware

If you do not always use the most recent version of the firmware when you update the instrument, it may not function properly. When you update the module firmware or purchase a newly released module, be sure to also update the frame controller firmware.

You can download the latest firmware from the YOKOGAWA Web site if you register as a user.
You can register as a user from the following Web site.
http://www.yokogawa.com/tm/

Note

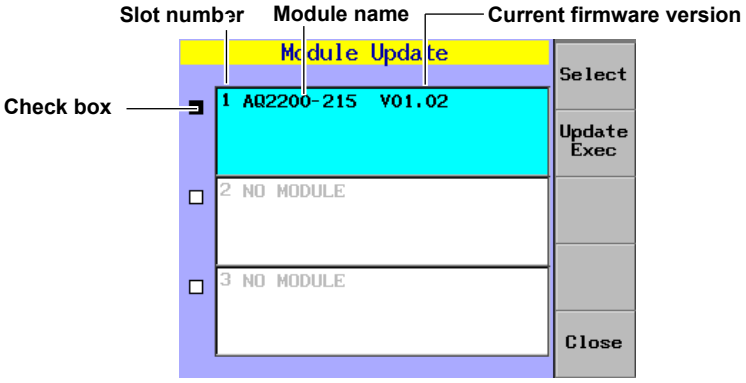
- You cannot use the frame controller's Ethernet port to connect to the Internet and directly download or update the firmware.
- You cannot update the firmware through a PC.

Things to Prepare before Updating the Firmware

- The frame controller
- The modules that you want to update
- A USB memory device (containing the most recent firmware)
  Be sure to save the most recent firmware program files to the root folder of the USB memory device. (Save the module program files to the Module folder.)
  The firmware will be updated properly even if unrelated files or folders are on the USB memory device.

Explanation of the Module Selection Screen and Features

You can select which modules you want to update the firmware for.



Item	Description
Check box	Displays whether the module will have its firmware updated or not. You can use the Select soft key to select modules. Selected modules have a black check box. Unselected modules have a white check box.
Slot number	Displays the slot number.
Module name	Displays the module name. If no module is installed, “NO MODULE” is displayed.
Current firmware version	Displays the current version of the firmware for the installed module.
Select	Switches whether the module will have its firmware updated or not.
Update Exec	Executes the firmware update.
Close	Returns to the SYSTEM screen.

Displaying Instrument Information

The instrument information appears in the following formats. The details are different depending on the instrument.

Frame Controller

Item	Description	Display Example
PRODUCT	Manufacturing company	YOKOGAWA
MODEL CODE	Model	735101
SERIAL NO.	Serial number	00001
OPTION	Options	NONE
SPECIAL CODE	Special code	00000
BOOT VER.	Boot program edition	1.00-00
FIRM VER.	Firmware edition	1.00-00
FPGA1 VER.	Hardware part edition	1.00-00
FPGA2 VER.	Hardware part edition	1.00-00
MAC ADDRESS	Ethernet MAC address	01:02:03:04:05:06

Modules

Item	Description	Display Example
PRODUCT	Manufacturing company	YOKOGAWA
MODULE NAME	Module name	AQ2200-211 Sensor Module
SERIAL NO.	Serial number	00001
ORDER CODE	Order code	735125-FCC
SPECIAL CODE	Special code	00000
FIRM VER.	Module firmware edition	01.00
HARD VER.	Hardware edition	1.00-00
FPGA VER.	Hardware part edition	1.00-00
OPTION	Options	NONE
CONNECTOR	Compliant connector	FC
FIBER	Compliant fiber	SM
WAVELENGTH	Wavelength	1564.679
FREE WORD	Comment	NONE

4.5 Routine Maintenance

Notes before Storage

Wipe the instrument off with a cloth to remove dust, fingerprints, and other dirt.
For instructions on how to clean the exterior of the instrument, see “Cleaning the Frame Controller and Modules.”
Carry out the condition check (fan alarm) and key check to confirm that the instrument operates correctly. For details, see section 10.7 in IM 735101-03E.

Notes When Re-Using the Instrument

When using the instrument again after storing it for a long period of time, first check that it operates correctly. Check that it operates correctly in the same way that was outlined above in the section “Notes before Storage.”

Cleaning the Frame Controller and Modules

To use this instrument for as long as possible and to prevent problems or malfunctions, routine maintenance is necessary.

- When cleaning the case or the operation panel, first remove the power cord from the outlet, and then wipe with a dry, soft, clean cloth.
- To clean the electrical interface, use compressed air to remove dust, and then cover unused output terminals with terminators and unused input terminals with caps.

CAUTION

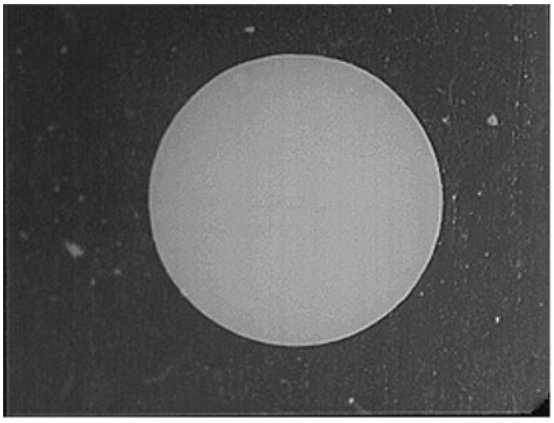
Failure to comply with the following precautions may cause the instrument to malfunction.

- Turn the instrument off before starting maintenance.
- Do not use chemicals such as thinner, benzene, or alcohol.
  Doing so may cause discoloration and deformation.

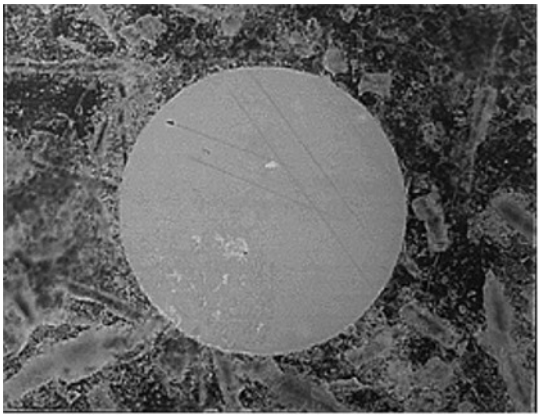
Why It Is Necessary to Clean the Optical Interface

The optical connectors and optical plugs are the only optical components whose optical fiber end faces are exposed to the outside. Even a tiny scratch on their end faces that cannot be detected by the naked eye greatly affects their optical performance. If optical connectors are connected improperly, if they are connected without the removal of dust or dirt, or if they are cleaned improperly, the optical connector end faces may be damaged.
When connecting optical connectors, you must properly align the ferrule cores of both optical connectors. An optical adapter is used for this connection, but if the connection is made with dirt or dust attached to the ferrule side face or ferrule guide (sleeve) of the optical adapter, the cores cannot be properly aligned. This may lead to problems such as optical power loss, transmission mode disturbances, and an increased optical reflection at the connection point. Consequently, the instrument will not be able to take proper measurements.
To prevent problems such as these, it is necessary to keep the optical connectors clean and to make proper connections when connecting optical connectors to measuring instruments or to other optical connectors.
When you use this instrument, clean the ferrule every time it is connected and clean the precision sleeve at least once every thirty connections. In particular, if you use optical connectors such as those described on the following page, we recommend that you clean them before every use.

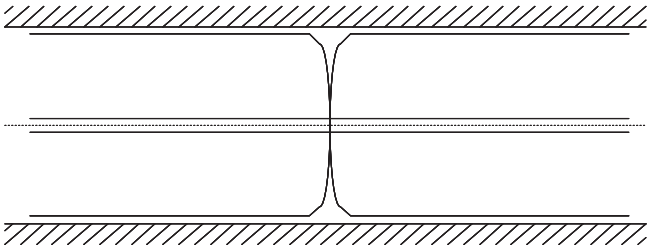
- Optical connectors are connected after a metallic sleeve has been inserted
  → Particles that are worn off of the metallic sleeve may stick to the ferrule side face or end face particularly easily.
- Optical connectors that have ferrule materials that easily wear out, such as metallic or crystallized glass ferrule
  → Ferrule particles may wear off easily from connecting and disconnecting the optical connector.
- Optical connectors and precision sleeves, with which plastic shell type optical connectors are repeatedly engaged
  → Plastic particles wear off easily from the repeated engagement of the shell.



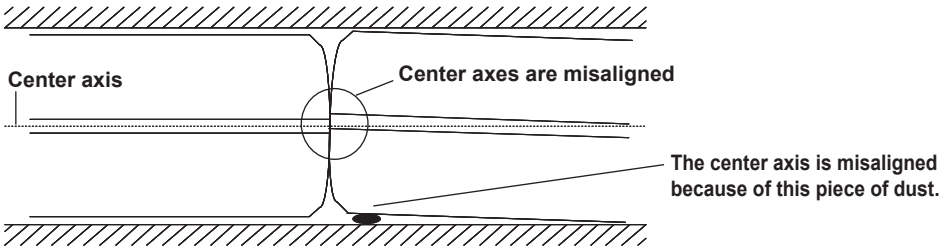
Enlarged photo of a good optical connector connection



Enlarged photo of a scratched optical connector connection



Correctly aligned optical connectors



Optical connectors whose axes are misaligned due to a piece of dust

Tools Required for Cleaning Optical Interfaces

When cleaning an optical interface, prepare the following:

- Isopropyl alcohol
- Cleaning paper
- Stick-type cleaners
- Compressed air
- An optical connector end face magnifying microscope

WARNING

Do not clean optical connectors or optical adapters while the laser beam is being generated. The laser beam is invisible. However, if it comes in contact with your eye it may cause eye damage.

How to Clean Optical Connectors

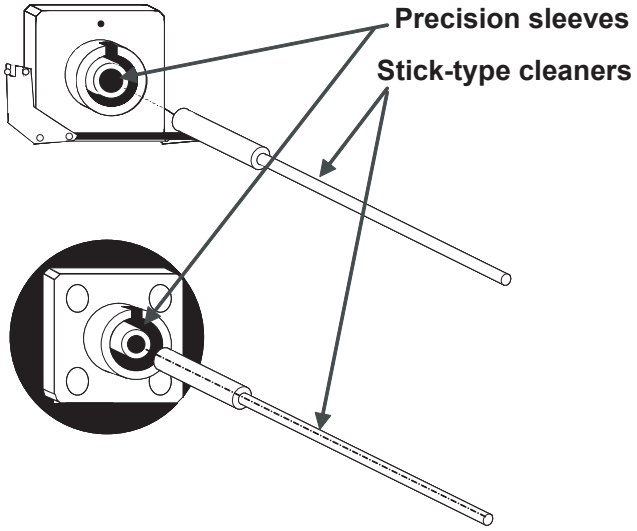
1. Soak a piece of cleaning paper in the isopropyl alcohol, and pinch the cleaning paper on the sides of the optical ferrule. Rub the sides of the ferrule with the cleaning paper.
2. Soak another piece of cleaning paper in the isopropyl alcohol, and rub the cleaning paper against the ferrule end face.
3. Wipe of the moisture with another piece of cleaning paper. After that, use the compressed air to remove any remaining dust.
4. Use the optical connector end face magnifying microscope to inspect the end face. Repeat the cleaning process until the end face is clear of dirt and dust.

CAUTION

If you use dirty cleaning paper, you may damage the end face. Always use new pieces of cleaning paper.

How to Clean the AQ9441 and AQ9335C Optical Connector Adapters

1. Soak a stick-type cleaner in the isopropyl alcohol, and slowly insert it into the optical connector adapter's precision sleeve. Use the stick-type cleaner to clean the adapter's inner walls.
2. Wipe of the moisture with another stick-type cleaner. After that, use the compressed air to remove any remaining dust.



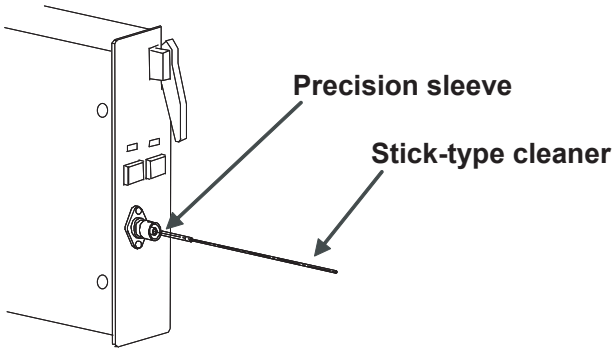
How to Clean the AQ9447 Optical Connector Adapter

Wipe the dust off the adapter, or use the compressed air to remove the dust.

How to Clean the Each Module

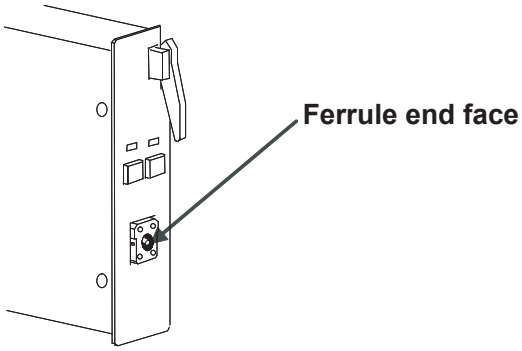
How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module

1. Soak a stick-type cleaner in the isopropyl alcohol, and slowly insert it into the optical output connector's precision sleeve. Rotate the stick-type cleaner while pressing lightly against the inner walls.



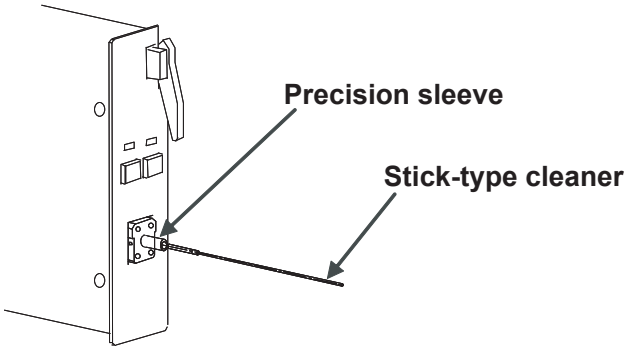
How to Clean the Optical Output Connector of the AQ2200-141 and AQ2200-142 FP-LD Modules

1. Soak a piece of cleaning paper in the isopropyl alcohol, and rub the cleaning paper against the ferrule end face.
2. Wipe of the moisture with another piece of cleaning paper. After that, use the compressed air to remove any remaining dust.



How to Clean the Optical Input Connector of the AQ2200-211 Sensor Module

1. Soak a stick-type cleaner in the isopropyl alcohol, and slowly insert it into the optical input connector's precision sleeve. Use the stick-type cleaner to clean the connector's inner walls and opening.
2. Wipe of the moisture with another stick-type cleaner. After that, use the compressed air to remove any remaining dust.



How to Clean the Optical Input Connector of the AQ2200-215 Sensor Module

Because the light receiving surface is very sensitive, never rub it to clean off dust particles.
Use the compressed air to remove small amounts of dust and dirt.

How to Clean the Optical Input Connector of the AQ2200-221 Optical Sensor Head

An antireflection coating is applied to the light receiving glass of the AQ2200-221 optical sensor head.
Using a brush that has been used many times or a brush that has not been used for a long time may scratch the light receiving glass. Use new brushes when cleaning this optical input connector.

1. Use the compressed air to remove small amounts of dust and dirt.
2. If there is dirt or dust that you cannot remove with the compressed air, soak a piece of cleaning paper in the isopropyl alcohol, and softly wipe the surface of the light receiving glass. Then, use the compressed air to remove any lint that remains on the light receiving glass.

CAUTION

Wipe the light receiving glass softly. Strong pressure may scratch the glass or break the components.

How to Clean the Optical I/O Connectors of the AQ2200-136 TLS Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-621/622 10 Gbit/s Optical Modulator

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-631 10 Gbit/s Optical Receiver

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical Input Connector of the AQ2200-231 Optical Sensor Head

See “How to Clean the Optical Input Connector of the AQ2200-221 Optical Sensor Head.”

How to Clean the Optical Input Connector of the AQ2200-241 Optical Sensor Head

Because the light receiving surface is very sensitive, never rub it to clean off dust particles.
Use the compressed air to remove small amounts of dust and dirt.

How to Clean the Optical I/O Connectors of the AQ2200-311 ATTN Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-311A ATTN Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-331 ATTN Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-411/412 OSW Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-421 OSW Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-271 ORL Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

How to Clean the Optical I/O Connectors of the AQ2200-131/132 Grid TLS Module

See “How to Clean the Optical Output Connector of the AQ2200-111 DFB-LD Module.”

Precautions for Routine Use

To protect the optical interfaces, always strictly observe the following points during routine use.

- To prevent dust from adhering to the optical interfaces, always attach dust protection caps to the optical connectors and the instrument's optical interfaces that are not being used.
- To prevent the connector end faces from getting dirty or being damaged, never touch the optical interfaces with anything (except when cleaning them or carrying out adjustments).
- When connecting the optical connectors, always insert them straight so that the connector end face does not touch the connector adapter, the nearby panel, or nearby components.

4.6 Recommended Replacement Parts

The following parts are susceptible to wear. We recommend replacing them at the following intervals. For part replacement, contact your nearest YOKOGAWA dealer.

Part Name	Recommended Replacement Interval	Notes
Cooling fan	40000 hours	
Lithium battery	3 years	If the instrument is turned off
ATTN module shutter	150000 times	AQ2200-311/311A/331 ATTN module

Part Name	Operating Life	Notes
LCD backlight	30000 hours*	Half brightness life for continuous use

* This is the operating life if the display adjustment “Back Light” setting is set to 5 (the default value).

4.7 Calibration

Periodic calibration is an effective means of keeping the instrument performing correctly for a long time and of detecting malfunctions at an early stage.
We recommend that you calibrate this instrument at least once a year.

- Calibration of the AQ2200-111
  Due to the properties of the semiconductors (semiconductor lasers) that the AQ2200-111 uses, the actual wavelength may deviate from the specified wavelength over time.
  To maintain consistent performance, calibrate and adjust the instrument once every six months.
  If YOKOGAWA calibrates the instrument, we can also perform adjustments as requested.
  If you calibrate the instrument, you can adjust it by entering the correction values that you obtained from the calibration into the instrument's CAL_Offset

5.1 AQ2211/AQ2212 Frame Controller

Performance and Functional Specifications

Item		Specifications
Number of slots		AQ2211: 3 AQ2212: 9
Display		Color LCD, 320 × 240 dots
Storage		
USB storage		USB Mass Storage Class flash memory. See “USB (for peripheral devices).”
Output format		
	Setup parameters	Proprietary format
	Measurement data	Log data: .csv Stability data: .csv Wavelength sweep data: .csv BERT log data: .txt Screen captures: .bmp, .jpg, and .png
Interface		
GP-IB	Electrical and mechanical specifications	Complies with IEEE488[1]
	Functional specifications	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, and C0
	Protocol	Complies with IEEE488.2
	Code	ISO (ASCII)
	Mode	Addressable mode
	Addresses	0 to 30
	Clearing remote mode	The LOCAL soft key can be pressed to clear remote mode (except during Local Lockout).
Ethernet	Number of ports	1
	Connector type	RJ-45
	Electrical and mechanical specifications	Complies with IEEE802.3[1]
	Transmission system	Ethernet (100BASE-Tx)
	Transfer rate	100 Mbps max.
	Communication protocol	TCP/IP
	Supported services	DHCP and remote control. (Remote control supports a maximum of five users.)
	Ports	0 to 65535; port 10001 is reserved for the TMCTL protocol
USB (For connecting to a PC)	Number of ports	1
	Connector type	USB type B (receptacle)
	Electrical and mechanical specifications	Complies with USB Rev 1.1[1]
	Data rate	12 Mbps max.
	Supported protocols	USB-TMC
	Supported services	Remote control
	PC system requirements	The PC must be running Windows 2000 (SP4 or later), Windows XP, or Windows Vista and must have a standard USB port.[2]
USB (for peripheral devices)	Number of ports	1
	Connector type	USB type A (receptacle)
	Electrical and mechanical specifications	Complies with USB Rev 2.0[1]
	Data rate	480 Mbps max.
	Compatible devices	USB Mass Storage Class flash memory
	Number of devices that can be connected	1
	Power supply	5 V, 500 mA
Trigger unit	Connector type	BNC[1]
	Trigger in	TTL level input Input pulse width: 50 μs or greater Input impedance: approx. 5 kΩ
	Trigger out	TTL level output Output pulse width: approx. 50 μs Output impedance: approx. 100 Ω
Interlock connector unit	Connector type	BNC[1] Contact input

1 Use cables of 3 m or less in length.
2 A separate driver is required.

General Specifications

Item	Specifications	
Operating environment		Ambient temperature: 5 to 40°C Ambient humidity: 20 to 80% RH (no condensation) Altitude: 2000 m or less
Storage environment		Ambient temperature: –20 to 60°C Ambient humidity: 20 to 80% RH (no condensation) Altitude: 3000 m or less
Rated supply voltage		100 to 240 VAC
Rated supply frequency		50/60 Hz
Maximum power consumption		AQ2211: 170 VA (including installed modules) AQ2212: 580 VA (including installed modules)
Withstand voltage (between the power supply and case)		1.5 kVAC for 1 minute
Insulation resistance (between the power supply and case)		500 VDC, 10 MΩ or greater
External dimensions		AQ2211: 212 (W) × 132.5 (H) × 400 (D) mm (excluding protrusions) AQ2212: 425 (W) × 132.5 (H) × 500 (D) mm (excluding protrusions)
Weight		AQ2211: approx. 6 kg (not including installed modules) AQ2212: approx. 11 kg (not including installed modules)
Safety standard	Compliant standard	EN 61010-1 Overvoltage category (installation category) II[1] Pollution degree 2[2] EN 60825-1 (Laser safety)
Emissions	Compliant standard	EN 61326-1 class A EN 55011 class A, group 1 C-Tick EN 55011 class A, group 1 EN 61000-3-2 EN 61000-3-3 This is a class A instrument designed for an industrial environment. Operation of this equipment in a residential area can cause radio interference, in which case users will be required to correct the interference.
	Cable conditions	
		Interlock connector (REMOTE INTERLOCK) Use a BNC coaxial cable that is 3 m in length or less.
		External trigger input terminal (TRIGGER IN) Use a BNC coaxial cable that is 3 m in length or less.
		External trigger output terminal (TRIGGER OUT) Use a BNC coaxial cable that is 3 m in length or less.
		USB port (type A) Use a shielded USB cable that is 3 m in length or less.
		USB port (type B) Use a shielded USB cable that is 3 m in length or less.
		Ethernet port Use a category 7 Ethernet cable that is 3 m in length or less.
Immunity	Compliant standard	EN 61326-1 Table 2 (for industrial locations)
	Cable conditions	Same as the emission cable conditions.

1 The overvoltage category (installation category) is a value used to define the transient overvoltage condition and includes the rated impulse withstand voltage. Overvoltage category II applies to electrical equipment that is powered through a fixed installation, such as a switchboard.

2 The pollution degree refers to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).

5.2 AQ2200-111 DFB-LD Module

Performance and Functional Specifications

Item	Specifications
Center wavelength	1310 nm, 1490 nm: ±10 nm
	1524.111 to 1620.500 nm: As stated in the table of supported wavelengths
Specifiable wavelength range	1310, 1490, and 1524.111 to 1620.500 nm[1]
Wavelength accuracy[2, 17]	1310 nm, 1490 nm: ±0.05 nm or less
	1524.111 to 1620.500 nm: ±0.02 nm or less
Wavelength setting resolution	0.001 nm
Compliant optical fiber	SM (ITU-T G.652)
Spectrum line width[3]	NARROW: 5 MHz (typical)
	WIDE: 100 MHz (typical)
Optical output level[2, 4]	10 mW or greater
SMSR[3]	1310, 1490 nm: 30 dB or greater
	1524.111 to 1620.500 nm: 45 dB (typical)
Optical output level stability[5]	15 minutes: ±0.005 dB or less
	24 hours: ± 0.03 dB or less
Wavelength stability[2]	15 minutes: ±0.005 nm or less
	24 hours: ±0.01 nm or less
Wavelength adjustment width[2, 6]	1.6 nm or greater
Optical attenuation range	10 dB (in 0.01 dB steps)
RIN[3, 7]	–145 dB/Hz (typical)
Optical output modulation; internal CHOP modulation	
	Modulation frequency: 100 Hz to 300 kHz
Compliant optical connector[8]	FC/Angled PC

Optional Specifications

Item	Specifications
High output option[2]	
Optical output[4, 16]	20 mW or greater
PMF option	
Polarization extinction ratio[9]	20 dB or greater
External sine modulation option[10, 16]	
Modulation frequency	100 Hz to 300 kHz
Input connector	SMA[12]
Input impedance	Approx. 50 Ω
Maximum input voltage	2 Vp-p
External CHOP modulation option[10, 16]	
Modulation frequency	100 Hz to 300 kHz
External modulation optical pulse delay time	1 μs (typical)[13, 14]
External modulation optical pulse rise time	1 μs or less[13, 15]
External modulation optical pulse fall time	1 μs (typical)[13, 15]
Input connector	SMA[12]
Input impedance	Approx. 2 kΩ
Input level	TTL level

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	Ambient temperature: –20 to +60°C Ambient humidity: 20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.9 kg
Safety standard	EN 60825-1 class 1M

* All values in the specifications assume a warm-up period of one hour.

1 The range of wavelengths that you can specify complies with the ITU-T grid.

2 Ambient temperature: 23 ± 2°C (constant temperature), CW light, attenuation: 0.0 dB, center wavelength, outgoing point of connection fiber (FC/Angled PC-FC/SPC, 2 m, SMF), spectrum line width: NARROW

3 CW light, attenuation: 0.0 dB, center wavelength

4 When using the master cord

5 Ambient temperature: 23 ± 2°C (constant temperature), CW light, attenuation: 0.0 dB, center wavelength, outgoing point of connection fiber (FC/Angled PC-FC/SPC, 2 m, SMF), spectrum line width: WIDE

6 Setting resolution: 0.001 nm, reference wavelength: ±0.4 nm or greater

7 Spectrum line width: NARROW, frequency: 100 kHz to 2.5 GHz

8 Seiko Giken Angled PC or an equivalent (step type)

9 CW light, attenuation: 0.0 dB, spectrum line width: NARROW, outgoing end of the optical connector mounted on the panel

10 The external sine modulation option and external CHOP modulation option cannot be selected at the same time.

11 Input modulation signal: 2 Vp-p or less

12 Use a 50 Ω coaxial cable that is 3 m in length or less to connect the external modulation input connector.

13 Modulation signal: 100 Hz, attenuation: 0.0 dB, spectrum line width: NARROW

14 Modulated optical output delay time for the input modulation signal.

15 10 to 90% of the optical output signal rise or fall time.

16 You cannot select the high output and external modulation options for the 1490 nm wavelength.

17 During shipping (not including changes due to the passage of time)

DFB-LD Module Table of Supported Wavelengths

Optical frequency: THz, Wavelength: nm

Wavelength Code	Optical Frequency	Wavelength	Wavelength Code	Optical Frequency	Wavelength	Wavelength Code	Optical Frequency	Wavelength
M0290	191.60	1564.679	M0085	193.55	1548.915	M0480	195.50	1533.465
M0275	191.65	1564.271	M0100	193.60	1548.515	M0485	195.55	1533.073
M0270	191.70	1563.863	M0105	193.65	1548.115	M0500	195.60	1532.681
M0255	191.75	1563.455	M0120	193.70	1547.715	M0505	195.65	1532.290
M0250	191.80	1563.047	M0125	193.75	1547.316	M0520	195.70	1531.898
M0235	191.85	1562.640	M0140	193.80	1546.917	M0525	195.75	1531.507
M0230	191.90	1562.233	M0145	193.85	1546.518	M0540	195.80	1531.116
M0215	191.95	1561.826	M0160	193.90	1546.119	M0545	195.85	1530.725
M0210	192.00	1561.419	M0165	193.95	1545.720	M0560	195.90	1530.334
M0195	192.05	1561.013	M0180	194.00	1545.322	W1310	228.85	1310.000
M0190	192.10	1560.606	M0185	194.05	1544.924	W1490	201.203	1490.000
M0175	192.15	1560.200	M0200	194.10	1544.526			
M0170	192.20	1559.794	M0205	194.15	1544.128			
M0155	192.25	1559.389	M0220	194.20	1543.730			
M0150	192.30	1558.983	M0225	194.25	1543.333			
M0135	192.35	1558.578	M0240	194.30	1542.936			
M0130	192.40	1558.173	M0245	194.35	1542.539			
M0115	192.45	1557.768	M0260	194.40	1542.142			
M0110	192.50	1557.363	M0265	194.45	1541.746			
M0095	192.55	1556.959	M0280	194.50	1541.349			
M0090	192.60	1556.555	M0285	194.55	1540.953			
M0075	192.65	1556.151	M0300	194.60	1540.557			
M0070	192.70	1555.747	M0305	194.65	1540.162			
M0055	192.75	1555.343	M0320	194.70	1539.766			
M0050	192.80	1554.940	M0325	194.75	1539.371			
M0035	192.85	1554.537	M0340	194.80	1538.976			
M0030	192.90	1554.134	M0345	194.85	1538.581			
M0015	192.95	1553.731	M0360	194.90	1538.186			
M0010	193.00	1553.329	M0365	194.95	1537.792			
M0005	193.05	1552.926	M0380	195.00	1537.397			
M0000	193.10	1552.524	M0385	195.05	1537.003			
M000H	193.15	1552.122	M0400	195.10	1536.609			
M0020	193.20	1551.721	M0405	195.15	1536.216			
M0025	193.25	1551.319	M0420	195.20	1535.822			
M0040	193.30	1550.918	M0425	195.25	1535.429			
M0045	193.35	1550.517	M0440	195.30	1535.036			
M0060	193.40	1550.116	M0445	195.35	1534.643			
M0065	193.45	1549.715	M0460	195.40	1534.250			
M0080	193.50	1549.315	M0465	195.45	1533.858			

5.3 AQ2200-141/142 FP-LD Module

Performance and Functional Specifications

Item	Specifications	
Center wavelength[1, 2]	AQ2200-141:	1310 ± 20 nm (when 1310 nm is specified)
		1550 ± 20 nm (when 1550 nm is specified)
	AQ2200-142:	1310 ± 20 nm, 1550 ± 20 nm
Compliant optical fiber	SM (ITU-T G.652)	
Spectrum width[1, 2, 3]	AQ2200-141:	5 nm or less (when 1310 nm is specified)
		10 nm or less (when 1550 nm is specified)
	AQ2200-142:	5 nm or less (when 1310 nm is specified)
		10 nm or less (when 1550 nm is specified)
Optical output level[2]	AQ2200-141:	+0 dBm or greater
	AQ2200-142:	–1 dBm or greater
Optical output level stability		
Temperature stability[2, 4]	AQ2200-141:	0.2 dBp-p or less
	AQ2200-142:	0.3 dBp-p or less
Time stability[2]	15 minutes[5]	AQ2200-141: ±0.003 dB or less
		AQ2200-142: ±0.005 dB or less
	24 hours:[6]	±0.03 dB or less
Optical attenuation range	6 dB (in 0.01 dB steps)	
Optical output modulation		
Internal CHOP modulation frequency	270 Hz, 1 kHz, and 2 kHz	
Compliant optical connector[7]	AQ9441 universal adapter	

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	Ambient temperature: –20 to +60°C
	Ambient humidity: 20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.95 kg
Safety standard	EN 60825-1 class 1

* All values in the specifications assume a warm-up period of one hour.

1 Ambient temperature: 23 ± 2°C

2 CW light, attenuation: 0.0 dB, outgoing point of connection fiber (FC/SPC-FC/SPC, 2m, SMF)

3 RMS (2 σ, –20 dB)

4 5 to 40°C (8 hours)

5 Constant temperature (one temperature from 20 to 30°C)

6 5 to 40 ± 1°C

7 Select either FC or SC

5.4 AQ2200-131/132 Grid TLS Module

Performance and Functional Specifications

Item		Specifications	
		Suffix code -T2	Suffix code -T4
Number of channel	C,L-Band	1 (AQ2200-131) or 2 (AQ2200-132)	
Device type	C,L-Band	Advanced type	Standard type
Frequency (Wavelength) range	C-Band	196.25 THz to 191.50 THz (1527.60 nm to 1565.50 nm)	196.10 THz to 191.70 THz (1528.77 nm to 1563.86 nm)
	L-Band	190.95 THz to 186.35THz (1570.01 nm to 1608.76 nm)	190.90 THz to 186.50 THz (1570.42 nm to 1607.47 nm)
Grid spacing	C,LBand	100 GHz, 50 GHz, 25 GHz and Manual (min. 0.1 GHz)	100 GHz, 50 GHz
Frequency (Wavelength) setting resolution	C-Band	0.1 GHz(0.8 pm@1550 nm)	—
	L-Band	0.1 GHz(0.8 pm@1590 nm)	—
Frequency (Wavelength) fine turning range	C-Band	Typ. ±6 GHz (±48 pm@1550 nm)	—
	L-Band	Typ. ±6 GHz (±51 pm@1590 nm)	
Frequency (Wavelength) fine turning resolution	C-Band	Typ. 1 MHz (8 fm@1550 nm)	—
	L-Band	Typ. 1 MHz (8 fm@1590 nm)	
Absolute frequency (Wavelength) accuracy[1, 2, 4, 6]	C-Band	±2.5 GHz (±20 pm@1550 nm)	±2.5 GHz (±20 pm@1550 nm)
	L-Band	±2.5 GHz (±21 pm@1590 nm)	±2.5 GHz (±21 pm@1590 nm)
Frequency (Wavelength) tuning time	C-Band	30 seconds or less	
	L-Band		
Frequency (Wavelength) stability (24 hours)[1, 2, 3, 6]	C-Band	Typ. ±0.3 GHz (±2.4 pm@1550 nm)	Typ. ±0.3 GHz (±2.4 pm@1550 nm)
	L-Band	Typ. ±0.3 GHz (±2.5 pm@1590 nm)	Typ. ±0.3 GHz (±2.5 pm@1590 nm)
Optical output level[1, 2, 4, 6]	C-Band	≥ +12.5 dBm	≥ +12.0 dBm
	L-Band	≥ +12.5 dBm	≥ +9.0 dBm
Attenuation range	C,L-Band	6 dB (Resolution Typ. 0.01)	4 dB (Resolition Typ. 0.1)
Output level stability (24 hours)[1, 2, 3, 6]	C,L-Band	Typ. ±0.03 dB	Typ. ±0.03 dB
Spectral Linewidth[5, 6]	C,L-Band	Typ. 100 kHz	Typ. 3 MHz
SMSR[5, 6]	C,L-Band	Typ. 45 dB	Typ. 45 dB
RIN[5, 6, 7]	C-Band	Typ. –145 dB/Hz	Typ. –135 dB/Hz
	L-Band	Typ. –145 dB/Hz	Typ. –130 dB/Hz
Fiber type	C,L-Band	PANDA PMF Slow axis, in line with connector key	
Optical connector[8, 9]	C,L-Band	Select any of FC/PC[8] or FC/Angled PC[9]	
Dither function: SBS suppression dither frequency[10]	C,L-Band	20.8 kHz	—
Dither function: SBS suppression FM modulation range[10]	C,L-Band	0 to 1000 MHz	—
External dimensions	C,L-Band	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)	
Weight	C,L-Band	Approx. 0.8 kg	
Laser safety standard class	C,L-Band	IEC 60825-1:2007 class 1M	

After 30 minutes warm up.

The environmental conditions are subject to the specification of frame controller, unless otherwise specified

1 When a PM fiber is used.
2 Advanced type: At grid mode on, A grid spacing is except a manual setting.
3 At constant temperature (within ±0.5°C)
4 Ambient temperature: 23±5°C
5 Dither function: OFF
6 At maximum output power
7 20 MHz to 10 GHz
8 Optical return loss: 40 dB or more
9 Step type, narrow key
10 Characteristics

General Specifications

Item	specification
Operation environment	Ambient temperature 5 to 40°C, Ambient humidity 20 to 80% RH (no condensation)
Storage environment	Ambient temperature –20 to 60°C, Ambient humidity 20 to 80% RH (no condensation)

5.4 AQ2200-136 TLS Module

Performance and Functional Specifications

Item	Specifications
Variable wavelength width	1440 to 1640 nm
Wavelength setting resolution	1 pm
Absolute wavelength accuracy	≤ ±100 pm[1, 2]
Relative wavelength accuracy	≤ ±50 pm[1, 2]
Wavelength stability (over time)	±5 pm/h[4, 8, 10]
Spectrum line width	
NARROW	≤ 1 MHz[3, 4, 12]
WIDE	≥ 50 MHz[2, 4, 12]
Optical output	
Maximum output wavelength	≥ +7 dBm[2, 12]
1520 to 1610 nm	≥ +5 dBm[2, 12]
1475 to 1625 nm	≥ +1 dBm[2, 12]
Full-wavelength range	≥ –8 dBm[2, 12]
Optical output stability	
5 minutes	≤ ±0.01 dB[2, 6, 7, 10, 12]
1 hour	≤ ±0.05 dB[2, 6, 7, 10, 12]
24 hours	≤ ±0.1 dB[2, 6, 7, 10, 12]
Optical output reproducibility (for each wavelength)	≤ ±0.04 dB[2, 6, 7, 10, 12]
Variable optical output range	≥ 4 dB[5, 9, 12]
MONITOR output	
Maximum optical output	≤ +5 dBm[11]
Minimum optical output	≥ –25 dBm
Wavelength sweep speed	50 nm/s (maximum)
Compliant optical fiber	SM (ITU-T G.652)
Compliant optical connector	FC/Angled PC[13]

General Specifications

Item	Specifications
Operating temperature range	+10 to +35°C[14]
Storage temperature range	–10 to +50°C
Humidity conditions	20 to 80% RH (no condensation)
External dimensions	62.5 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; two slots)
Weight	Approx. 2 kg
Safety standard	EN 60825-1 class 1M

Unless otherwise specified, the specification values have been obtained under reference operating conditions,[15] with a 2m SMF output point, and after calibration has been completed one hour after OPT ON.

1 ±2 σ, line width: NARROW
2 At maximum optical output
3 At minimum optical output
4 Wavelength: 1590 nm
5 Wavelength: 1560 to 1610 nm
6 Wavelength: 1460 to 1620 nm
7 Line width: WIDE
8 Line width: NARROW
9 In 0.1 dB steps
10 Constant temperature
11 When using the MONITOR connector
12 When using the OUTPUT connector
13 Seiko Giken Angled PC or an equivalent (step type)
14 The frame controller's guaranteed operating temperature range is +5 to 40°C, but it is limited when this module is installed.
15 Ambient temperature: 23 ± 2°C, temperature change rate: 1°C/10 minutes or 3°C/hour, humidity: 50 ± 5%

5.5 AQ2200-201 Interface Module

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	Ambient temperature: –20 to +60°C Ambient humidity: 20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.8 kg

5.6 AQ2200-211 Sensor Module

Performance and Functional Specifications

Item	Specifications
Photo sensor element	InGaAs
Measurement wavelength range	700 to 1700 nm
Power range	
CW light	–110 to +10 dBm
CHOP light	–110 to +7 dBm
Minimum display resolution	1/10,000
Compliant optical fiber	≤ 62.5/125 μm (GI), NA ≤ 0.275
Uncertainty at reference conditions[1]	±2%
Total uncertainty[2]	±3.5% ± 0.5 pW
Polarization dependence[3]	0.005 dBp-p or less
Nonlinearity[4]	±0.015 dB ± 0.2 pW
Noise level[5]	
CW light	0.2 pW or less
CHOP light	0.2 pW or less
Averaging time (minimum)	100 μs
Analog output[6]	
AUTO mode	Approx. 0 to 2 V, proportional to the measurement power (W) for each power range
LINEAR mode	Approx. 0 to 2 V, proportional to the range set for measurement power (W)
LOG mode	Approx. 0 to 2 V, proportional to the range set for measurement power (dBm)
Connector type	Mini plug
Output impedance	Approx. 1 kΩ
Optical connector[7]	AQ9447* connector adapter
Logging measurement	
Measurement power range	Fixed
Minimum data sampling interval	100 μs
Maximum number of data samples	20,000
Stability measurement	
Minimum data sampling interval	100 ms
Maximum number of data samples	20,000
Maximum measurement time	99 days

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	Ambient temperature: –20 to +60°C Ambient humidity: 20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.8 kg

* All values in the specifications assume a warm-up period of one hour.

1 Reference conditions:
- Power level: 100 μW (–10 dBm), CW light
- Wavelength: 1310 ± 20 nm
- Light source spectrum width: 10 nm or less
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC
- Wavelength setting error: 0.5 nm or less
- Changes to the measuring instrument due to the passage of time are not included in these conditions. Add 0.5% for each year since the last calibration.

2 Operating conditions:
- Power level: 10 mW to 100 pW (–70 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±3% for wavelengths less than 1200 nm; add ±0.3 pW for wavelengths from 1600 to 1650 nm)
- Optical fiber: ≤ 50 GI, NA ≤ 0.2 (add ±1.5% if 62.5 GI and NA ≤ 0.275)
- Range: Auto range
- Averaging: 1 second
- Other conditions are the same as the reference conditions.

3 Conditions:
- Wavelength range: 1550 ± 30 nm
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC

4 Conditions:
- Power level: 10 mW to 100 pW (–70 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±0.3 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Optical fiber: SM (ITU-T G.652)
- Range: Auto range
- Averaging: 1 second

5 Conditions:
- Wavelength range: 1200 to 1600 nm (add ±0.3 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Averaging: 1 second

6 Output impedance: approx. 1 kΩ

7 Select FC, SC, or ST

5.7 AQ2200-215 Sensor Module

Performance and Functional Specifications

Item	Specifications
Photo sensor element	InGaAs
Measurement wavelength range	970 to 1660 nm
Power range	–70 to +30 dBm
Minimum display resolution	1/10,000
Compliant optical fiber	≤ 62.5/125 μm (GI), NA ≤ 0.275
Uncertainty at reference conditions[1]	±3%
Total uncertainty[2, 7]	±5% ± 2 nW
Polarization dependence[3]	0.03 dBp-p (typical)
Nonlinearity[4, 7]	±0.05 dB ± 2 nW
Noise level[5]	2 nW or less
Averaging time (minimum)	100 μs
Analog output	
AUTO mode	Approx. 0 to 2 V, proportional to the measurement power (W) for each power range
LINEAR mode	Approx. 0 to 2 V, proportional to the range set for measurement power (W)
LOG mode	Approx. 0 to 2 V, proportional to the range set for measurement power (dBm)
Connector type	Mini plug
Output impedance	Approx. 1 kΩ
Optical connector[6]	AQ9335C* connector adapter
Logging measurement	
Measurement power range	Fixed
Minimum data sampling interval	100 μs
Maximum number of data samples	20,000
Stability measurement	
Minimum data sampling interval	100 ms
Maximum number of data samples	20,000
Maximum measurement time	99 days

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.7 kg

* All values in the specifications assume a warm-up period of one hour.

1 Reference conditions:
- Power level: 100 μW (–10 dBm), CW light
- Wavelength: 1310 ± 20 nm
- Light source spectrum width: 10 nm or less
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC
- Wavelength setting error: 0.5 nm or less
- Changes to the measuring instrument due to the passage of time are not included in these conditions. Add 0.5% for each year since the last calibration.

2 Operating conditions:
- Power level: 1 μW to 1 W (–30 to +30 dBm), CW light
- Wavelength range: 1260 to 1620 nm
- Optical fiber: ≤ 50 GI, NA ≤ 0.2 (add ±2% if 62.5 GI and NA ≤ 0.275)
- Range: Auto range
- Averaging: 1 second
- Other conditions are the same as the reference conditions.

3 Conditions:
- Wavelength range: 1550 ± 30 nm
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC

4 Conditions:
- Power level: 1 μW to 1 W (–30 to +30 dBm), CW light
- Wavelength range: 1260 to 1620 nm
- Ambient temperature: 23 ± 2°C (constant temperature)
- Optical fiber: SM (ITU-T G.652)
- Range: Auto range
- Averaging: 1 second

5 Conditions:
- Wavelength range: 1260 to 1620 nm
- Ambient temperature: 23 ± 2°C (constant temperature)
- Averaging: 1 second

6 Select FC, SC, ST, LC, or MU

7 Add 0.001 dB/mW (typical) if the input power is greater than 10 mW.

5.8 AQ2200-221 Sensor Module

Performance and Functional Specifications

Item	Specifications
Photo sensor element	InGaAs, 3 mm diameter
Measurement wavelength range	800 to 1700 nm
Power range	–70 to +10 dBm
Minimum display resolution	1/10,000
Compliant optical fiber	≤ 62.5/125 μm (GI), NA ≤ 0.275
Uncertainty at reference conditions[1]	±3%
Total uncertainty[2]	±5% ± 50 pW
Polarization dependence[3]	0.02 dBp-p (typical)
Nonlinearity[4]	±0.02 dB ± 50 pW
Noise level[5]	50 pW or less
Averaging time (minimum)	200 μs
Optical connector[6]	AQ9335C connector adapter
Logging measurement	
Measurement power range	Fixed
Minimum data sampling interval	200 μs
Maximum number of data samples	10,000 data samples per channel
Stability measurement	
Minimum data sampling interval	100 ms
Maximum number of data samples	10,000 data samples per channel
Maximum measurement time	99 days

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.9 kg

* All values in the specifications assume a warm-up period of one hour.

1 Reference conditions:
- Power level: 100 μW (–10 dBm), CW light
- Wavelength: 1310 ± 20 nm
- Light source spectrum width: 10 nm or less
- Ambient temperature: 23 ± 1°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC
- Wavelength setting error: 0.5 nm or less
- Changes to the measuring instrument due to the passage of time are not included in these conditions. Add 0.5% for each year since the last calibration.

2 Operating conditions:
- Power level: 10 mW to 100 nW (–40 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±3% for wavelengths less than 1200 nm; add ±30 pW for wavelengths from 1600 to 1650 nm)
- Optical fiber: ≤ 50 GI, NA ≤ 0.2 (add ±2% if 62.5 GI and NA ≤ 0.275)
- Range: Auto range
- Averaging: 1 second
- Other conditions are the same as the reference conditions.

3 Conditions:
- Wavelength range: 1550 ± 30 nm
- Ambient temperature: 23 ± 1°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC

4 Conditions:
- Power level: 10 mW to 100 nW (–40 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±30 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 1°C (constant temperature)
- Optical fiber: SM (ITU-T G.652)
- Range: Auto range
- Averaging: 1 second

5 Conditions:
- Wavelength range: 1200 to 1600 nm (add ±30 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 1°C (constant temperature)
- Averaging: 1 second

6 Select FC, SC, ST, LC, or MU

5.9 AQ2200-231/241 Optical Sensor Head

Performance and Functional Specifications

Item	Specifications
Photo sensor element	AQ2200-231: InGaAs, 5 mm diameter
	AQ2200-241: Si, 10 mm diameter
Measurement wavelength range	AQ2200-231: 800 to 1700 nm
	AQ2200-241: 400 to 1100 nm
Power range	CW light: –90 to +10 dBm
	CHOP light: –90 to +7 dBm
Minimum display resolution	1/10,000
Compliant optical fiber[1]	AQ2200-231: ≤ 100/140 μm (SI), NA ≤ 0.3
	AQ2200-241: ≤ 200/230 μm (SI), NA ≤ 0.5
Uncertainty at reference conditions	AQ2200-231: ±2%[2]
	AQ2200-241: ±2.5%[3]
Total uncertainty	AQ2200-231: ±3.5% ± 50 pW[4]
	AQ2200-241: ±5% ± 50 pW[5]
Polarization dependence	AQ2200-231: 0.025 dBp-p or less[6]
Nonlinearity	AQ2200-231: ±0.015 dB ± 50 pW[7]
	AQ2200-241: ±0.05 dB ± 50 pW[8]
Noise level[9, 10]	
CW light	50 pW or less
CHOP light	50 pW or less
Averaging time (minimum)	100 μs
Analog output	
AUTO mode	Approx. 0 to 2 V, proportional to the measurement power (W) for each power range
LINEAR mode	Approx. 0 to 2 V, proportional to the range set for measurement power (W)
LOG mode	Approx. 0 to 2 V, proportional to the range set for measurement power (dBm)
Connector type	Mini plug
Output impedance	Approx. 1 kΩ
Optical connector[11]	AQ9335C connector adapter
Logging measurement	
Measurement power range	Fixed
Minimum data sampling interval	100 μs
Maximum number of data samples	20,000
Stability measurement	
Minimum data sampling interval	100 ms
Maximum number of data samples	20,000
Maximum measurement time	99 days

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	61 (W) × 42 (H) × 100 (D) mm (excluding protrusions)
Weight	Approx. 0.3 kg

* All values in the specifications assume a warm-up period of one hour.

1 Depends on the AQ9335C* and the diameter of the light receiving sensor. You can also perform atmospheric light measurements by removing the connector adapter.

2 Reference conditions:
- Power level: 100 μW (–10 dBm), CW light
- Wavelength: 1310 ± 20 nm
- Light source spectrum width: 10 nm or less
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC
- Wavelength setting error: 0.5 nm or less
- Changes to the measuring instrument due to the passage of time are not included in these conditions. Add 0.5% for each year since the last calibration.

3 Reference conditions:
- Power level: 100 μW (–10 dBm), CW light
- Wavelength: 850 ± 10 nm
- Light source spectrum width: 10 nm or less
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC
- Wavelength setting error: 0.5 nm or less
- Changes to the measuring instrument due to the passage of time are not included in these conditions. Add 0.5% for each year since the last calibration.

4 Operating conditions:
- Power level: 10 mW to 1 nW (–60 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±3% for wavelengths less than 1200 nm; add ±30 pW for wavelengths from 1600 to 1650 nm)
- Optical fiber: ≤ 50 GI, NA ≤ 0.2 (add ±1.5% if 100 SI and NA ≤ 0.3)
- Range: Auto range
- Averaging: 1 second
- Other operating conditions are the same as the reference conditions listed in note 2.

5 Operating conditions:
- Power level: 10 mW to 1 nW (–60 to +10 dBm), CW light
- Wavelength range: 500 to 900 nm (add ±2% ± 100 pW if the wavelength is less than 500 nm or greater than 900 nm)
- Optical fiber: ≤ 50 GI, NA ≤ 0.2 (add ±1.5% if 200 SI and NA ≤ 0.5)
- Range: Auto range
- Averaging: 1 second
- Other conditions are the same as the reference conditions listed in note 3

6 Conditions:
- Wavelength: 1550 nm
- Ambient temperature: 23 ± 2°C
- Optical fiber: SM (ITU-T G.652)
- Optical connector: FC/PC

7 Conditions:
- Power level: 10 mW to 1 nW (–60 to +10 dBm), CW light
- Wavelength range: 1200 to 1600 nm (add ±30 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Optical fiber: SM (ITU-T G.652)
- Range: Auto range
- Averaging: 1 second

8 Conditions:
- Power level: 10 mW to 1 nW (–60 to +10 dBm), CW light
- Wavelength range: 500 to 900 nm (add ±2% ± 100 pW if the wavelength is less than 500 nm or greater than 900 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Optical fiber: SM (ITU-T G.652)
- Range: Auto range
- Averaging: 1 second

9 Conditions for the AQ2200-231:
- Wavelength range: 1200 to 1600 nm (add ±30 pW for wavelengths from 1600 to 1650 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Averaging: 1 second

10 Conditions for the AQ2200-241:
- Wavelength range: 500 to 900 nm (add ±100 pW if the wavelength is less than 500 nm or greater than 900 nm)
- Ambient temperature: 23 ± 2°C (constant temperature)
- Averaging: 1 second

11 Select FC, SC, or ST

5.10 AQ2200-271 ORL Module

Performance and Functional Specifications

Item	Specifications
Wavelength range	1310 ± 30 nm, 1550 ± 30 nm
Directivity	68 dB or greater
Compliant optical fiber	SMF
Compliant optical measurement connector	SC/Angled PC
Compliant light source and sensor connector	FC/PC

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.7 kg

Return Loss Measurement Specifications

Item	Specifications	
System configuration		
Light source used	AQ2200-141 or AQ2200-142	
Sensor used	AQ2200-211	AQ2200-221
Wavelength range[1]	1310 ± 30 nm, 1550 ± 30 nm	
Measured dynamic range[2]	65 dB or greater	55 dB or greater
Relative measurement uncertainty[2, 3]		
RL ≤ 50 dB	±0.3 dB	±0.7 dB
RL ≤ 60 dB	±0.6 dB	–
Compliant optical fiber	SMF	
Compliant light source connector	FC/PC	
Compliant measurement connector	AC/Angled PC	

1 Depends on the wavelength of the light source used

2 23 ± 2°C when using a reference reflector and a YOKOGAWA-specified master cord at the Fresnel reflection reference. During use after calibration.

3 ±2 σ

5.11 AQ2200-311 ATTN Module

Performance and Functional Specifications

Item	Specifications	
Wavelength range	1200 to 1700 nm	
Insertion loss	1.0 dB (typical)[1, 2, 3, 4]	1.6 dB or less[1, 2, 3]
Maximum attenuation	60 dB	
Attenuation accuracy	± 0.1 dB or less[2, 3, 5, 6]	
Reproducibility	± 0.01 dB or less[1, 2, 7, 12]	
Display resolution	0.001 dB	
Return loss		
PC	45 dB or greater[3, 5, 8]	
Angled PC	60 dB or greater[3, 5, 9]	
Polarization dependence	0.08 dBp-p or less[3, 5]	
Maximum input power	+23 dBm	
Shutter isolation	90 dB or greater	
Compliant optical fiber	SM (ITU-T G.652)	
Compliant optical connector	FC/PC, SC/PC, FC/Angled PC, SC/Angled PC	

Optional Specifications

Item	Specifications
Monitor port option	
Monitor port output[10]	–13 dB (typical)
Insertion loss (output)	2.3 dB or less[1, 2, 3]
Return loss[11]	50 dB or greater[3, 5]
Polarization dependence (output)	0.1 dBp-p or less[3, 5]

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.9 kg

* All values in the specifications assume a warm-up period of one hour. Unless otherwise noted, all specified values include connectors.

1 Wavelength: 1550 ± 15 nm, 1310 ± 15 nm
2 Ambient temperature: 23 ± 2°C (constant temperature)
3 When using the master cord
4 Connectors not included
5 Wavelength: 1550 ± 15 nm
6 0.15 dB (typical) if the wavelength is 1310 ± 15 nm
7 2 σ
8 When using PC connector ends (return loss of 48 dB or greater)
9 When using Angled PC connector ends (return loss of 63 dB or greater)
10 Output ratio
11 For Angled PC connector ends
12 Polarization dependent loss not included

5.12 AQ2200-311A ATTN Module

Performance and Functional Specifications

Item	Specifications
Wavelength range	
SMF type	1200 to 1700 nm
MMF type	800 to 1370 nm
Insertion loss	
SMF type	1.0 dB (typical)[1, 2, 3, 4] 1.6 dB or less[1, 2, 3]
MMF type	1.0 dB (typical)[2, 4] 1.6 dB or less[2, 9]
Maximum attenuation	
SMF type	60 dB
MMF type	45 dB
Attenuation accuracy	
SMF type	± 0.1 dB or less[2, 3, 5, 6]
MMF type	± 0.1 dB or less[2, 8]
Reproducibility	
SMF type	± 0.01 dB or less[1, 2, 7]
MMF type	± 0.01 dB or less[2, 7, 8]
Display resolution	0.001 dB
Return loss	
SMF type	45 dB or greater[3, 5, 10]
MMF type	20 dB or greater[8]
Polarization dependency (SMF)	0.08 dBp-p or less[3, 5]
Maximum input power (SMF)	+23 dBm
Shutter isolation	90 dB or greater
Compliant optical fiber	
SMF type	SM (ITU-T G.652)
MMF type	62.5/125 GI (IEC 60793-2)
Compliant optical connector	FC/PC, SC/PC

Optional Specifications

Item	Specifications
Monitor port option	
Monitor port output[11]	
SMF	–13 dB (typical)[1, 2, 3]
MMF	–13 dB (typical)[2, 8]
Insertion loss (output)	
SMF	2.3 dB or less[1, 2, 3]
MMF	2.3 dB or less[2, 9]
Polarization dependence (output)	0.1 dBp-p or less[3, 5]

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.9 kg

* All values in the specifications assume a warm-up period of one hour. Unless otherwise noted, all specified values include connectors.

1 Wavelengthk: 1550 ± 15 nm, 1310 ± 15 nm
2 Ambient temperature: 23 ± 2°C (constant temperature)
3 When using the master cord (SMF)
4 Connectors not included
5 Wavelength: 1550 ± 15 nm
6 0.15 dB or less if the wavelength is 1310 ± 15 nm
7 2 σ
8 Wavelength: 850 or 1310 nm
9 +0.5 dB if the wavelength is 850 or 1310 nm
10 When using PC connectors (return loss 48 dB or greater)
11 Output ratio

5.13 AQ2200-331 ATTN Module

Performance and Functional Specifications

Item	Specifications
Wavelength range	
SMF type	1200 to 1700 nm
MMF type	800 to 1370 nm
Insertion loss	
SMF type	1.9 dB (typical)[1, 2, 3, 4]
MMF type	1.9 dB (typical)[2, 4, 14]
Maximum attenuation	
SMF type	60 dB
MMF type	45 dB
Attenuation accuracy	
SMF type	± 0.1 dB or less[2, 3, 5, 6]
MMF type	± 0.1 dB or less[2, 12]
Reproducibility	
SMF type	± 0.01 dB or less[1, 2, 7]
MMF type	± 0.01 dB or less[2, 7, 12]
Minimum display resolution	1/1,000
Output monitor accuracy	
SMF type	± 5% or less[2, 8, 9, 10]
MMF type	± 5% or less[2, 10, 13]
Return loss	
SMF type	45 dB or greater[3, 5, 11]
MMF type	20 dB or greater[12]
Polarization dependence[3, 5]	
SMF type	0.1 dBp-p or less
Maximum input power	+23 dBm
Shutter isolation	90 dB or greater
Compliant optical fiber	
SMF type	SM (ITU-T G.652)
MMF type	62.5/125 GI (IEC 60793-2)
Compliant optical connector	FC/PC, SC/PC

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.9 kg

- All values in the specifications assume a warm-up period of one hour.
- Unless otherwise noted, all specified values include connectors.
- For models with GI specifications, all specified values are guaranteed when a light source that is excited in steady mode is used.

1 Wavelength: 1310 ± 15 nm or 1550 ± 15 nm
2 Ambient temperature: 23 ± 2°C (constant temperature)
3 When using the master cord (SMF)
4 Connectors not included. 2.3 dB or less when connectors are included.
5 Wavelength: 1550 ± 15 nm
6 0.15 dB or less if the wavelength is 1310 ± 15 nm
7 2 σ
8 Polarization dependence is not included.
9 Any one wavelength within 1310 ± 15 nm or 1550 ± 15 nm
10 Output power: –10 dBm
11 When using PC connectors (return loss 48 dB or greater)
12 Wavelength: 850 or 1310 nm
13 Wavelength: 850 nm
14 Wavelength: 850 nm. Add 0.5 dB if the wavelength is 1310 nm.

5.14 AQ2200-411/412 OSW Module

Performance and Functional Specifications

Item	Specifications
Number of ports	1 × 4, 1 × 8, or 1 × 16
Wavelength range	
SMF type	1310 nm/1550 nm
MMF type	850 nm/1310 nm
Insertion loss	1.0 dB (typical)[1, 2, 3, 4]
Reproducibility	± 0.01 dB or less[1, 2, 5]
Crosstalk[1, 3]	
SMF type	–60 dB or less
MMF type	–50 dB or less
Return loss[1, 3, 6]	
SMF type	45 dB or greater
MMF type	20 dB or greater
Maximum input power	
SMF type	+23 dBm
Polarization dependence[1, 3]	
SMF type	0.08 dBp-p or less
Compliant optical fiber	
SMF type	SM (ITU-T G.652)
MMF type	62.5/125 GI (IEC 60793-2; only supports the AQ2200-411)
Compliant optical connector	FC/PC, SC/PC

General Specifications

Item		Specifications
Operating conditions		The same as the frame controller's operating environment
Temperature and humidity for storage		
	Ambient temperature	–20 to +60°C
	Ambient humidity	20 to 80% RH (no condensation)
External dimensions		
	1 × 4 and 1 × 8 ports	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
	1 × 16 ports	62.5 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; two slots)
Weight	1 × 4 and 1 × 8 ports	Approx. 0.8 kg
	1 × 16 ports	Approx. 1.5 kg

- All values in the specifications assume a warm-up period of one hour.
- Unless otherwise noted, all specified values include connectors.
- For models with GI specifications, all specified values are guaranteed when a light source that is excited in steady mode is used.

1 SMF type; wavelength: 1310 ± 15 nm or 1550 ± 15 nm
MMF type; wavelength: 850 or 1300 nm
2 Ambient temperature: 23 ± 2°C (constant temperature)
3 When using the master cord (SMF)
4 Connectors not included. 1.4 dB or less when connectors are included.
5 2 σ
6 SMF type: When using PC connectors (return loss 48 dB or greater)

5.15 AQ2200-421 OSW Module

Performance and Functional Specifications

Item	Specifications
Number of ports	
1 × 2 type	Dual 1 × 2
2 × 2 type	Dual 2 × 2
Wavelength range	
SMF type	1310 nm/1550 nm
MMF type	850 nm/1310 nm
Insertion loss	1.0 dB (typical)[1, 2, 3, 4]
Reproducibility	± 0.01 dB or less[1, 2, 5]
Crosstalk	–50 dB or less[1, 3]
Return loss[1, 3, 6]	
SMF type	45 dB or greater
MMF type	20 dB or greater
Polarization dependence[3, 7]	
SMF type	0.08 dBp-p or less
Compliant optical fiber	
SMF type	SM (ITU-T G.652)
MMF type	62.5/125 GI (IEC 60793-2)
Compliant optical connector	FC/PC, SC/PC

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Temperature and humidity for storage	
Ambient temperature	–20 to +60°C
Ambient humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 0.7 kg

- All values in the specifications assume a warm-up period of one hour.
- Unless otherwise noted, all specified values include connectors.
- For models with GI specifications, all specified values are guaranteed when a light source that is excited in steady mode is used.

1 SMF type; wavelength: 1310 ± 15 nm or 1550 ± 15 nm
MMF type; wavelength: 850 or 1300 nm
2 Ambient temperature: 23 ± 2°C (constant temperature)
3 When using the master cord (SMF)
4 Connectors not included. 1.4 dB or less when connectors are included.
5 2 σ
6 SMF type: When using PC connectors (return loss 48 dB or greater)
7 Wavelength: 1550 ± 15 nm

5.16 AQ2200-601 10 Gbit/s BERT Module

Performance and Functional Specifications

Item		Specifications
Pulse Pattern Generator Interface		
Data output (DATA OUT DATA OUT)	Bitrate	9.95 to 11.32 Gbit/s
	Data format	NRZ
	Output amplitude	0.5 to 2.0 Vp-p (in 10 mV steps)
	Tr/Tf (20 to 80%)	25 ps or less
	Offset voltage	–2 to +3 V (in 10 mV steps)
	Cross point	30 to 70% (in 1% steps)
	Number of outputs	2 (non-inverted and inverted)
	Connectors	3.5 mm, female
	Output terminator conditions	50 Ω AC or DC terminator
	Inversion feature	Positive/negative logic inversion
	Output control	On/off function (GND level when off)
Data output (DATA OUT TO OPTICAL MODULATOR)	Output amplitude	0.50 ± 0.1 Vp-p
	Offset voltage	0 V (fixed)
	Cross point	50% (nominal value)
	Number of outputs	1
	Connector	3.5 mm, female
	Output terminator conditions	50 Ω AC terminator
	Inversion feature	Positive/negative logic inversion
	Output control	On/off function (GND level when off)
Clock output (CLOCK OUT CLOCK OUT)	Output amplitude	0.6 Vp-p (typical) AC-coupling
	Duty	50 ± 10%
	Tr/Tf (20 to 80%)	25 ps or less
	Offset	–2 to +3 V (in 10 mV steps)
	Number of outputs	2 (non-inverted and inverted)
	Connectors	SMA, female
	Output terminator conditions	50 Ω AC or DC terminator
	Output control	On/off function (GND level when off)
Error Detector Interface		
Data input (DATA IN 1 (CDR))	Bitrate	9.95 to 11.32 Gbit/s
	Allowable bitrate	±100 ppm of the PPG's operation bitrate
	Input amplitude range	0.1 to 0.7 Vp-p
	Minimum input sensitivity	100 mVp-p or less[1]
	Threshold voltage	±0.35 V (in 1 mV steps)
	Data format	NRZ
	Inversion feature	Positive/negative logic inversion
	Connector	3.5 mm, female
	Input terminator conditions	50 Ω AC-coupling
Data input (DATA IN 2)	Bitrate	9.95 to 10.71 Gbit/s
	Input amplitude range	0.1 to 0.6 Vp-p
	Minimum input sensitivity	100 mVp-p or less[1]
	Threshold voltage	±0.3 V (in 1 mV steps)
	Inversion feature	Positive/negative logic inversion
	Connector	3.5 mm, female
	Input terminator conditions	50 Ω AC-coupling
Clock input (CLOCK IN)	Frequency	The same frequency as DATA IN 2 (synchronized to the data input)
	Input amplitude range	0.2 to 0.6 Vp-p
	Connector	SMA, female
	Input terminator conditions	50 Ω AC-coupling
Clock and Common Interface		
Operation clock	Clock mode	Internal clock (Internal), external reference clock (REF Clk), and external clock (EXT Clk)
Internal clock	Frequency range	9.95 to 11.32 GHz
	Resolution	1 kHz
External reference clock	Input frequency	1/16 or 1/64 of the bitrate
	Input amplitude	0.4 to 1.0 Vp-p

Item		Specifications
(REF CLOCK IN)	Duty	50%-rectangular signal (nominal)
	Connector	SMA, female
	Input terminator conditions	50 Ω AC-coupling
External clock	Input frequency	The same frequency as the bitrate
(EXT CLOCK IN)	Input amplitude	0.4 to 1.0 Vp-p
	Duty	50% (nominal value)
	Connector	SMA, female
	Input terminator conditions	50 Ω AC-coupling or DC-coupling
Trigger output	Trigger type	Clock trigger, pattern trigger, or error trigger
(TRIGGER OUT)	Clock trigger	TX1/16, TX1/64, RX1/16, or RX1/64
		A frequency that is 1/16 or 1/64 of the clock frequency
	Pattern trigger	TXPatt or RXPatt
		• PRBS Transmits high pulses at an interval that is 128 times larger than the PRBS pattern
		• Program (16 to 256 bits) Transmits high pulses at an interval that is 128 times larger than the pattern length
		• Program (256 to 67,108,864 bits) Transmits high pulses at an interval that is equivalent to the pattern length
		• SDH/SONET Transmits high pulses at an interval that is equivalent to one frame (1244160 bits)
	Error trigger	TXERR or RXERR
		Transmits a high pulse when an error is added in the PPG or when an error is detected in the ED.
	Output level	0.6 Vp-p ± 0.3 V
	Connector	SMA, female
	Output terminator conditions	50 Ω AC or DC terminator
Pulse Pattern Generator Data		
Transmission pattern	PRBS	2n-1 (n: 7, 9, 10, 11, 15, 23, or 31)
	PROGRAM	Standard: 16 to 256 bits (in 1-bit steps)
		Optional: 256 to 67,108,864 bits (in 128-bit steps)
	SDH/SONET	Optional
		Scramble: Fixed to ON
		Overhead: Programmable. The B1 and B2 bytes are program data. (They are provided with no computational parity bits.)
		Payload: PRBS 2n-1 (n: 9, 10, 11, 15, 23, or 31)
Error addition	SINGLE	Add a 1-bit error each time the user specifies it
	RATE	1.0E-n (n: 3 to 12 in steps of 1)
Error Detector Data		
Receive pattern	PRBS	2n-1 (n: 7, 9, 10, 11, 15, 23, or 31)
	PROGRAM	Standard: 16 to 256 bits (in 1-bit steps)
		Optional: 256 to 67,108,864 bits (in 128-bit steps)
	SDH/SONET	Optional
		Descramble: Fixed to ON
		Overhead: Programmable. The B1 and B2 bytes are program data. (They are provided with no computational parity bits.)
		Payload: PRBS 2n-1 (n: 9, 10, 11, 15, 23, or 31)
AUTO SYNC		ON, OFF
Measurement function	Measurement mode	Manual: Measurements begin when the MEASUREMENT START button is pressed and stop when the STOP button is pressed. (If the measurement continues for 10 days, it will be stopped automatically.)
		Single: A single measurement is carried out at the user-specified time. (The measurement stops automatically.)
		Repeat: Measurements are repeatedly carried out at the user-specified time.
	Measurement time	10 days at the maximum
	Measurement result	Current, 100 ms, or Last
	Measurement items	Sync loss, Error count, Error rate, Overhead error count, Overhead error rate, TX bitrate, RX bitrate, and Receive opt pwr[2], ATT Power mon[3]
	Error log	Available

General Specifications

Item		Specifications
Operating conditions		The same as the frame controller's operating environment
Temperature and humidity for storage	Ambient temperature	–10 to +50°C
	Ambient humidity	20 to 80% RH (no condensation)
Dimensions and weight	Dimensions	94 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; three slots)
	Weight	Approx. 2.6 kg

- All values in the specifications assume a warm-up period of one hour.

1 Specified for PPG-ED loopback measurements under the PRBS31 and data crosspoint 50% conditions.

2 Only selectable if an optical modulator module (AQ2200-621 or AQ2200-622) and an optical receiver module (AQ2200-631) are used at the same time.

3 Only selectable if an ATTN module (AQ2200-331) is used at the same time.

5.17 AQ2200-621/622 10 Gbit/s Optical Modulator

Performance and Functional Specifications

Item	Specifications
Wavelength range[1]	AQ2200-621: 1530 to 1570 nm
	AQ2200-622: 1290 to 1330 nm
Wavelength variation	As stated in the specifications for the AQ2200-111 DFB-LD module
Optical power variation	As stated in the specifications for the AQ2200-111 DFB-LD module
LN Cut type[1]	X-cut or Z-cut
Optical insertion loss[2]	7 dB (typical), 10 dB or less
Maximum optical input	16 dBm
Optical input range for guaranteed performance[3, 5]	9 to 13 dBm
Extinction ratio[3, 4, 6]	AQ2200-621: 12 dB or greater at 1550 nm
	AQ2200-622: 12 dB or greater at 1310 nm
Tr/Tf (20 to 80%)[3, 4]	25 ps or less
Electric input amplitude[3]	500 ± 100 mVp-p (AC-coupling)
Maximum absolute input amplitude	1200 mVp-p (AC-coupling)
Compliant electric connector	3.5 mm jack or equivalent
Compliant optical connector (LD IN)	SC/PC
Compliant optical connector (OPTICAL DATA OUT)[1]	SC/PC or FC/PC
Compliant optical fiber	PMF (key-aligned slow axis) is used inside of the module.
	(You can connect a PMF or SMF to OPTICAL DATA OUT.)

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Storage temperature	–10 to +50°C
Storage humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 1.0 kg

1 Select either option

2 Includes modulation loss due to NRZ coding (mark ratio 50%)

3 Use the DATA OUT TO OPTICAL MODULATOR terminal of an AQ2200-601 BERT module and an AQ2200-111 DFB-LD module with /PMF option. Use the specified U-links (optional) and PMF (optional) to connect the modules. Use the 10 GHz CLOCK OUT terminal to generate triggers for monitoring waveforms. If you want to monitor optical waveforms, use an SMF that is 1 m or less in length.

4 Temperature range for guaranteed performance: 23 ± 5°C

5 This is the range in which the Auto-Bias Control operates stably.

6 Within the optical input range for guaranteed performance

Unless otherwise specified, the specifications apply to NRZ and PRBS31 (mark ratio 50%) coding.

5.18 AQ2200-631 10 Gbit/s Optical Receiver

Performance and Functional Specifications

Item	Specifications
Wavelength range	1290 to 1330 nm or 1530 to 1570 nm
Minimum optical receiving sensitivity[1, 2]	< –15 dBm at 1550 nm, Ex = 12 dB, 9.953 Gbit/s, PRBS31 < –14 dBm at 1310 nm, Ex = 12 dB, 9.953 Gbit/s, PRBS31
Maximum optical input	6 dBm peak, 3 dBm average
Overload[1, 2]	–1 dBm or greater
Saturated output amplitude[1]	300 mVp-p or greater (AC-coupling)
Electric connector	3.5 mm jack or equivalent
Optical connector[3]	SC/PC or FC/PC
Optical fiber	SMF

General Specifications

Item	Specifications
Operating conditions	The same as the frame controller's operating environment
Storage temperature	–10 to +50°C
Storage humidity	20 to 80% RH (no condensation)
External dimensions	31 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; one slot)
Weight	Approx. 1.0 kg

1 Use the DATA OUT TO OPTICAL MODULATOR terminal (on the PPG side) and a DATA IN terminal (on the ED side) of an AQ2200-601 BERT module, an AQ2200-111 DFB-LD module with /PMF option, and an AQ2200-621/622 Optical Modulator.
Use the specified U-links (optional) and PMF (optional) to connect the modules. Use an SMF that is 1 m or less in length to connect the modules in a loopback configuration.

2 Temperature range for guaranteed performance: 23 ± 5°C

3 Select either option

5.19 AQ2200-641 XFP Interface Module

Performance and Functional Specifications

Item		Specifications
Data input (DATA IN $\overline{\text{DATA IN}}$)[1]	Data format	NRZ
	Connector	3.5 mm, female
Data output (DATA OUT $\overline{\text{DATA OUT}}$)[2]	Data format	NRZ
	Connector	3.5 mm, female
Reference clock input	Input level	0.6 Vp-p ± 0.3 V
	Input frequency	1/64 of the bitrate
	Connector	SMA, female
Number of times the transceiver can be installed and uninstalled		200

General Specifications

Item		Specifications
Operating conditions		The same as the frame controller's operating environment
Storage temperature		–20 to +60°C
Storage humidity		20 to 80% RH (no condensation)
Dimensions and weight	Dimensions	62.5 (W) × 117 (H) × 321.5 (D) mm (excluding protrusions; two slots)
	Weight	Approx. 1.0 kg

1 Direct input to the XFP optical transceiver

2 Direct output from the XFP optical transceiver

5.20 AQ2200-642 Transceiver I/F Module

Monitoring Specifications

Name		Rating		Measurement Range			Accuracy*
		Upper	Lower	Upper	Lower	Resolution	
Power supply voltage monitor	PS1	+7.5 V	–0.5 V	+6 V	+2 V	1 mV	±(0.2% of reading + 1 mV)
	PS2	+7.5 V	–0.5 V	+4 V	+2 V		
	PS3	+7.5 V	–0.5 V	+2.5 V	+0.5 V		
	PS4	–7.5 V	+0.5 V	–2 V	–6 V		
	PS5	+7.5 V	–0.5 V	+6 V	+2 V		
Power supply current monitor	PS1	—	—	1.8A	0A	1 mA	±(1% of reading + 2 mA)
	PS2			3 A	0 A		
	PS3			1.8 A	0 A		
	PS4			3 A	0 A		
	PS5			2 A	0 A		
Status signal monitor	AIN1	+7.5 V	–0.5 V	+6 V	+0 V	0.01 V	±(1% of reading + 20 mV)
	AIN2						
	AIN3						
	AIN4						
	AIN5						
	AIN6						
Resistance value monitor	R1	—	—	10000 Ω	0 Ω	1 Ω	±(0.5% of reading +2 Ω)
Power consumption monitor	PSPOWER	—	—	28 W	0 W	0.1 W	See the values for the voltage and current monitors.

Power Supply Specifications

Name	Voltage Range	Current Limit Range
PS1	+4.750 to +5.250 V	0.10 to 1.80 A
PS2	+3.135 to +3.465 V	0.10 to 3.00 A
PS3	+0.800 to +1.890 V	0.10 to 1.80 A
PS4	–5.460 to –4.940 V	0.10 to 3.00 A
PS5	5.0 or 3.3 V	0.10 to 1.00 A (when 5.0 V is selected)
		0.10 to 2.00 A (when 3.3 V is selected)

Control Signal Transmission Specifications

Item	Specification		
DC response			
	CTRL01(1.2V) to CTRL07(1.2V)	VOLmax	0.2 V (100 µA), 0.3 V (1 mA)
		VOHmin	1.0 V (100 µA), 0.9 V (1 mA)
		IOLmax	+1 mA
		IOHmin	–1 mA
	CTRL08(3.3V) to CTRL17(3.3V)	VOLmax	0.5 V(3 mA)
		VOHmin	2.5 V(3 mA)
		IOLmax	+3 mA
		IOHmin	–3 mA

I²C Bus Signal Specifications

Item		Specification	
Signal rate		100/400 kHz	
DC response			
	SDA	VOLmax	0.5 V
		VOHmin	—(Open Drain)
		IOLmax	+3 mA
		IOHmax	—(Open Drain)
		VILmax	0.7 V
		VIHmax	1.7 V
	SCL	VOLmax	0.5 V
		VOHmin	—(Open Drain)
		IOLmax	+3 mA
		IOHmax	—(Open Drain)
		VILmax	0.7 V
		VIHmax	1.7 V

MDIO Bus Signal Specifications

Item		Specification	
Signal rate		625 kHz/1.25 MHz/ 2.5 MHz	
DC response			
	MDIO	VOLmax	0.35 V
		VOHmin	—(Open Drain)
		IOLmax	+3 mA
		IOHmax	—(Open Drain)
		VILmax	0.2 V
		VIHmax	1.0 V
	MDC	VOLmax	0.35 V
		VOHmin	0.85 V (3 mA)
		IOLmax	+3 mA
		IOHmax	+3 mA
		VILmax	—
		VIHmax	—

General Specifications

Item		Specification
Operating conditions		The same as the frame controller's operating environment
Storage temperature		–20 to +60°C
Storage humidity		20 to 80% RH (no condensation)
Dimensions and weight	Dimensions	62.5 × 117 × 321.5 mm (excluding protrusions; two slots)
	Weight	Approx. 1.5 kg

1 Assuming an ambient temperature of 23 ± 2°C and a warm-up period of 20 minutes.

5.21 AQ2200-651 SG Module

Performance and Functional Specifications

Item			Specification
RF OUT(CH1-CH5)	Frequency range		620.0 to 720.0 MHz (when the rate is 1/1)
			155.0 to 180.0 MHz (when the rate is 1/4)
	Frequency resolution		1 Hz
	Frequency accuracy		±2.0 ppm (when using the internal oscillator) Depends on the signal received by 10 MHz REF IN (when using an external reference signal)
	Output	amplitude	0.8 Vp-p ± 0.2 Vp-p
			1.3 Vp-p ± 0.2 Vp-p
		Waveform	Rectangular
		Duty	50 ± 10%
		Terminator condition	50 Ω AC-coupling
	Connector		SMA, female
10MHz REF IN	Input	Frequency range	10 MHz ± 2.0 ppm
		amplitude	0.3 Vp-p to 1.2 Vp-p
		Duty	50 ± 10%
		Absolute max. rating	1.5 Vp-p
		Terminator condition	50 Ω AC-coupling
	Connector		SMA, female
10MHz REF OUT	Output	Frequency range	10 MHz ± 2.0 ppm (when using the internal oscillator) Depends on the signal received by 10 MHz REF IN (when using an external reference signal)
		amplitude	0.8 Vp-p ± 0.2 Vp-p
		Terminator condition	50 Ω AC-coupling
	Connector		SMA, female

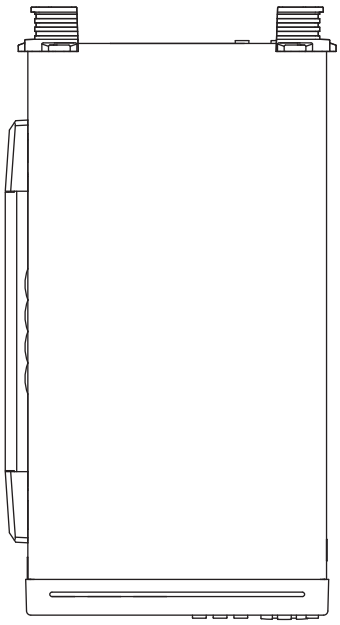
General Specifications

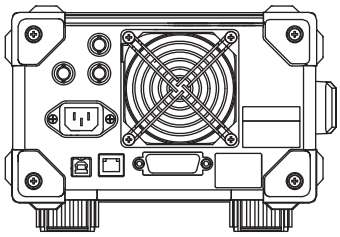
Item		Specification
Operating conditions		The same as the frame controller's operating environment
Storage temperature		–20 to +60°C
Storage humidity		20 to 80% RH (no condensation)
Dimensions and weight	Dimensions	62.5 × 117 × 321.5 mm (excluding protrusions; two slots)
	Weight	Approx. 1.5 kg

5.20 External Dimensions

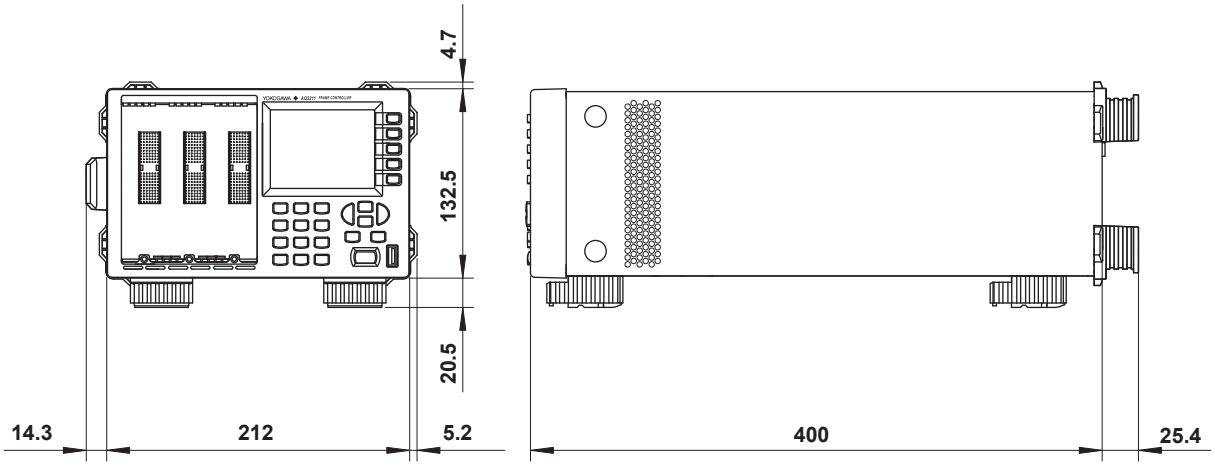
Unit: mm
Unless otherwise specified, tolerances are ±3% (however, tolerances are ±0.3 mm when below 10 mm).

AQ2211 Frame Controller

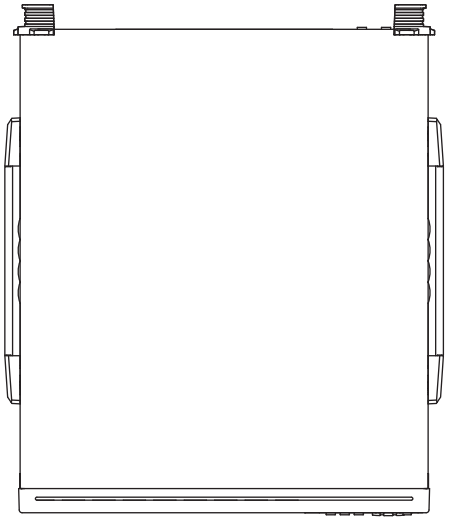


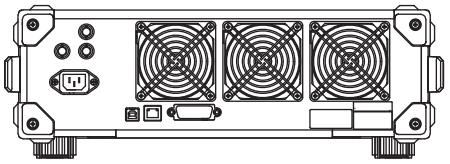


Rear view

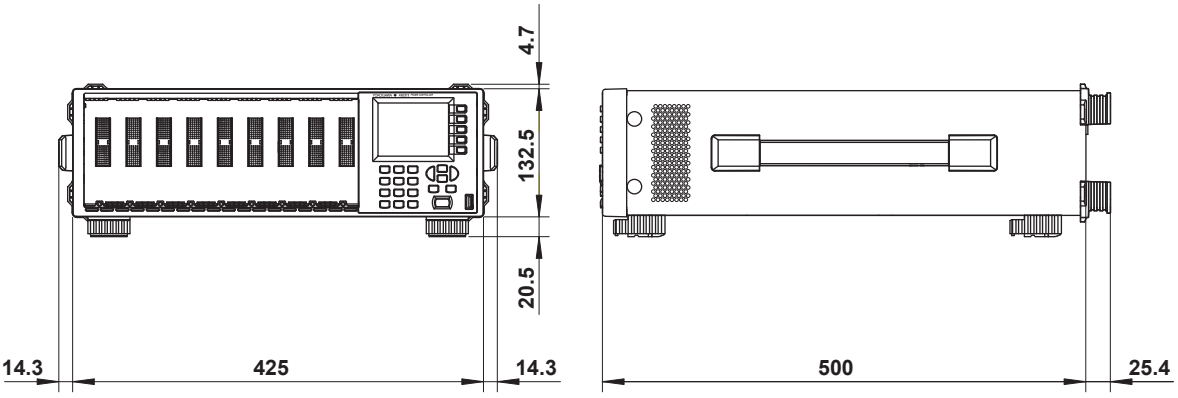


AQ2212 Frame Controller

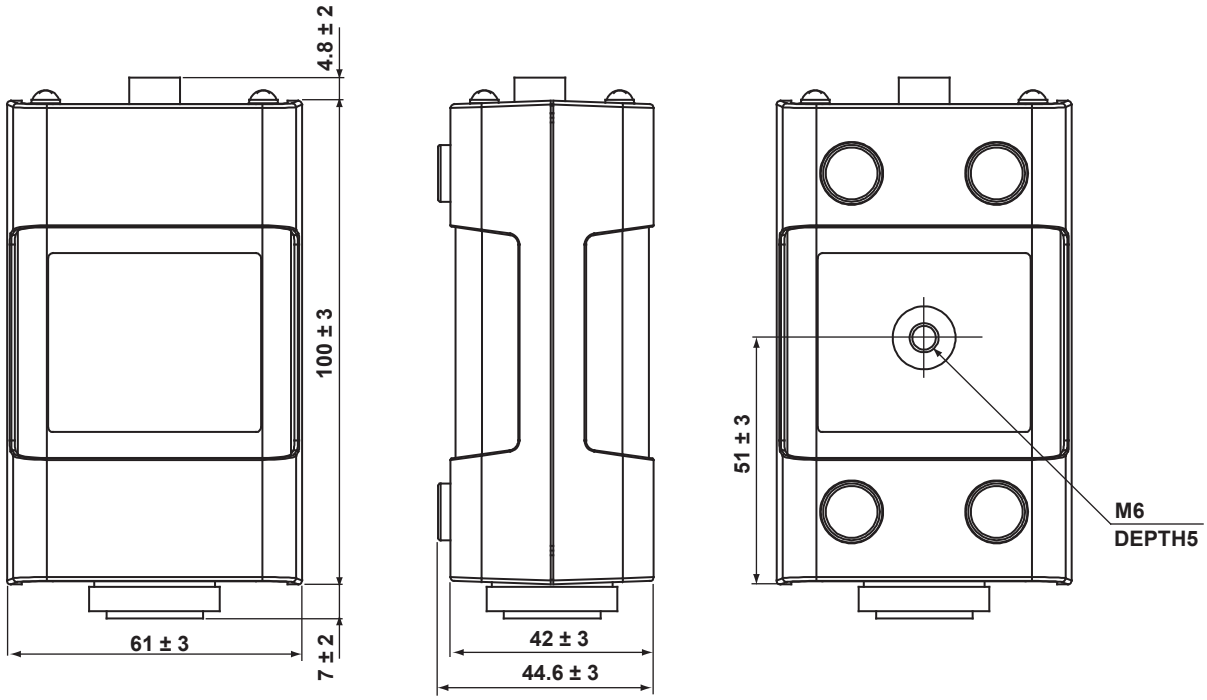




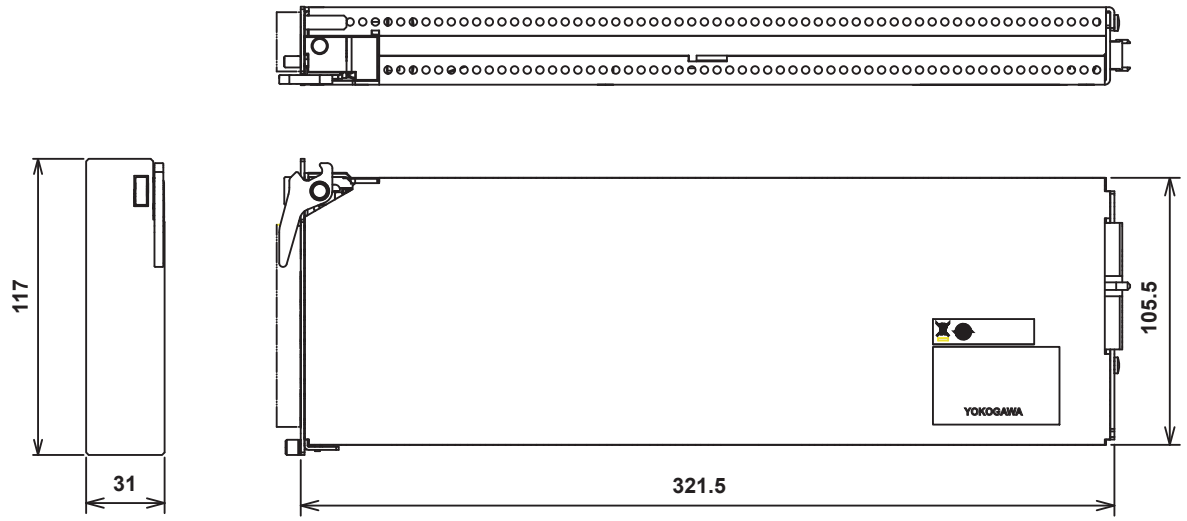
Rear view



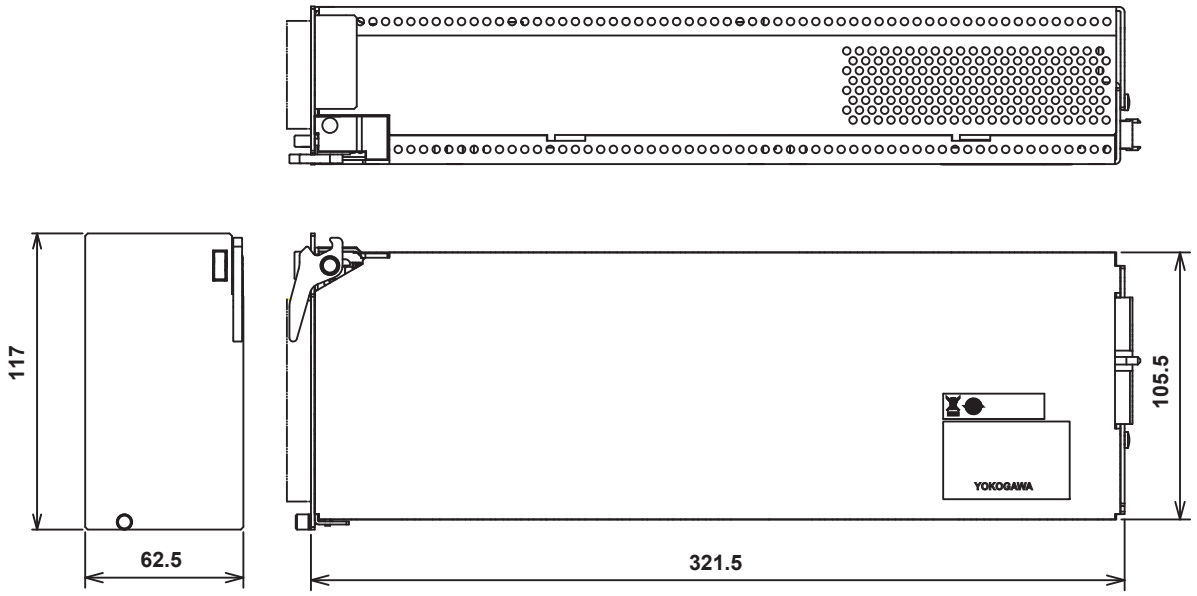
AQ2200-231 Optical Sensor Head



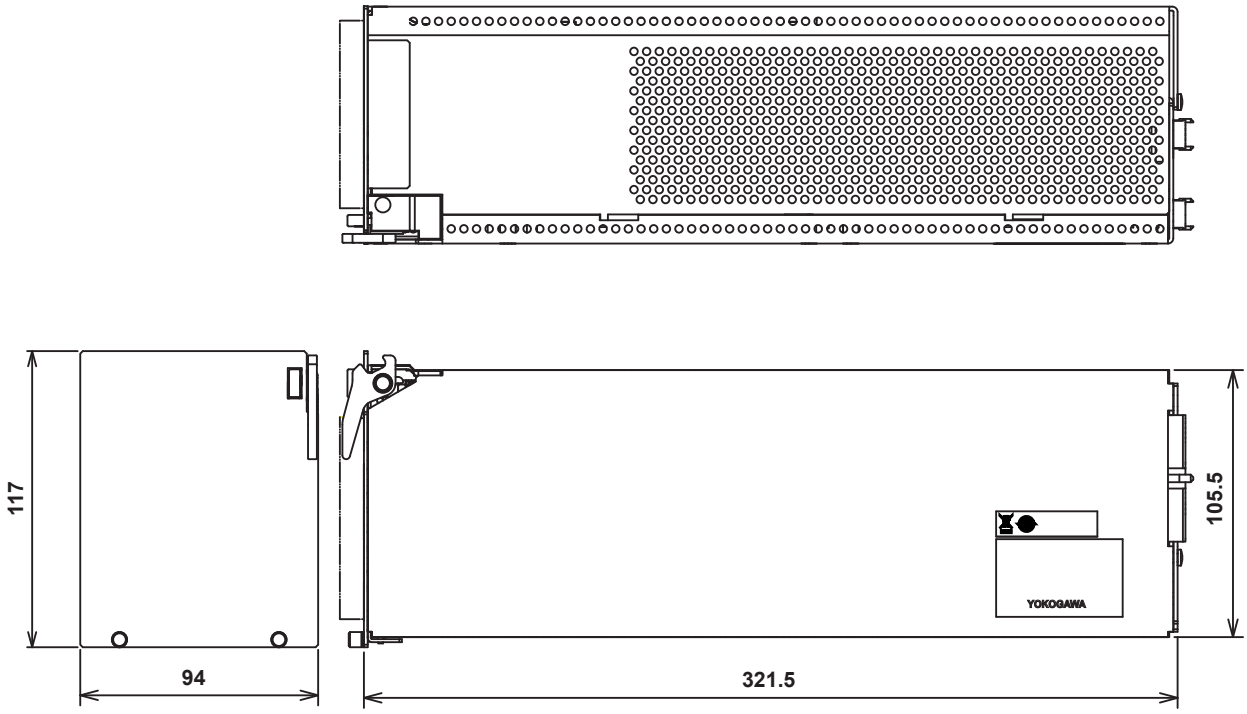
AQ2200 Series 1-Slot Size Module



AQ2200 Series 2-Slot Size Module



AQ2200 Series 3-Slot Size Module



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